SCIENCE

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MEMORIAL OF THE FIRST HALF CENTURY OF THE SMITHSONIAN INSTITUTION.

THE Smithsonian Institution was established by a law signed by President Polk, on August 10, 1846, and on the approach of the fiftieth anniversary of this event the Secretary and the Board of Regents began preparations for its commemoration. It was deemed impracticable to summon delegates from the world-wide affiliated scientific institutions to an assemblage in Washington, and therefore it was decided, as the simplest and most effective means of celebrating the jubilee, to publish a volume containing an account of the history, achievements and present condition of the Smithsonian Institution.

Such is the origin of the superb work recently issued by the Institution; superb in its mechanical features, dignified in its plan, and of incalculable value as a record of a most remarkable outcome of the legacy of James Smithson. The editorial supervision of the book was at first placed in the hands of Dr. James C. Welling, a Regent, but his untimely death necessitated the selection of another, and it was confided to Dr. G. Brown Goode, the Assistant Secretary, who had already drawn up the original plan. Unhappily Dr. Goode died before the completion of the task, but the manuscript was so far advanced that the task was finished upon the lines laid down by him.

The work is divided into two parts; the first deals with the History of the Smithsonian Institution in a series of chapters by the officers, and the second part consists of 'Appreciations of the Work' of the Institution, in fifteen chapters, written by scientists not organically connected therewith.

Samuel Pierpont Langley, Secretary of the Smithsonian, contributes a biography of James Smithson, based upon official records and embodying results of investigations made in England in 1894. From these it appears that owing to an erroneous inscription on Smithson's tomb at Genoa, the date of his birth has been usually given inaccurately; a record in Pembroke College places Smithson's birth in 1765, eleven years later than that previously assigned.

Professor Langley gives a graphic sketch of Smithson's life and scientific publications, and reproduces his notable will, all of which is familiar ground to readers of SCIENCE. Smithson once wrote: "The best blood of England flows in my veins; on my father's side I am a Northumberland, on my mother's I am related to kings, but this avails me not. My name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten." This youthful ambition seems to have occurred to him at the time of making his will, for he bequeathed his property (under certain limitations) 'to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men.'

Smithson's monument is the Institution bearing his name; his grave at Genoa has been recently marked by a tablet placed by the Smithsonian, with an inscription naming him as its founder.

In a chapter on 'The Founding of the Institution 1835–1846,' Dr. George Brown Goode chronicles the events of the long period that elapsed between the receipt of the legacy by the United States in 1838 and the passage of the law establishing the Institution in 1846, during which plans of organization were discussed in Congress and in the press. A great university, an astronomical observatory, an agricultural school, a public library, a museum of natural history and geology, and other schemes, were advocated only to be discarded, and the final draft of the bill adopted was the result of a compromise. Dr. Goode points out the relations between the 'National Institution to promote science and the useful arts' and the proposed Smithsonian Institution; the former was founded in 1840 on a broad and liberal plan, and some of its members thought it ought to be custodian of the Smithson legacy. This was not sustained, but it is interesting to note that the Smithsonian Institution as finally organized followed quite closely the lines of the National Institution both as respects its superior officers and its list of objects.

Many influential persons contributed to the plan of organization. Dr. Goode points out that several of the most important features were due to Joel R. Poinsett, of South Carolina, viz.: The idea of an imposing and permanent building, the plan of a national museum with a staff of curators, the location of the Institution on the Mall, the main features of the Establishment, and the system of international exchanges of books. The library project was largely due to Rufus Choate and George P. Marsh, and the success in harmonizing the various plans that had been under discussion for ten years was due to Robert Dale Owen.

In the next succeeding chapter the same writer deals with the 'Establishment' and the Board of Regents, in an appendix to which Mr. William Jones Rhees gives concise biographies of the 129 distinguished persons who have filled the office of Regent.

A chapter of special interest is that on

'The Three Secretaries,' also by Dr. Goode. Joseph Henry, Spencer Fullerton Baird and Stephen Pierpont Langley are names indelibly grafted on American science, each occupying a distinct field. Henry's well-digested 'Programme of Organization,' the corner-stone of the edifice on which Baird built, has been often described. These sketches are written in a pleasing, forceful style, and contain biographies of the persons as well as their contributions to science and their labors for the Smithsonian Institution. That of the present Secretary contains details not easily found elsewhere.

Professor Langley writes of the 'Benefactors' of the Smithsonian, of which the most conspicuous is Thomas George Hodgkins, whose gift of $200,000 in 1891 created an epoch in the history of the Institution. The Hodgkins medals and prizes, recently awarded, and the capital prize to the discoverers of argon are well known.

The erection of the buildings and the care of the grounds are treated in a chapter by Dr. Goode. The corner-stone of the Norman building was laid May 1, 1847, and it was occupied in 1855, the structure having been paid for out of accumulated interest of the Smithson Fund. This fact is typical of the prudent management that has characterized the financial policy of the Secretaries and the Regents from the beginning, so that the present fund is double that of the original bequest of Smithson.

'The Smithsonian Library' and the 'Publications' are discussed in two distinct chapters by Dr. Cyrus Adler, and closely related to these is a chapter on 'The International Exchange System' by Professor William Crawford Winlock. These cover very fully what may be called the literary activity of the Smithsonian.

The idea of forming a great library was one of the earliest projects, even antedating the Institution itself, and at the outset a large proportion of the income was devoted to this feature; the transfer to the Library of Congress as a 'deposit' in 1866 was an excellent move, especially in view of the magnificent edifice in which the collection is now housed.

More than one of the writers pay high tribute to the learning and efficiency of the first librarian, Professor Charles Coffin Jewett, who filled the office from 1847 to 1855. The Smithsonian Deposit now numbers 357,000 books, pamphlets, periodicals and maps. The formation of this splendid library has been accomplished largely through the system of international exchanges, the magnitude of which is shown by the item that in 1895 107,118 packages weighing about 164 tons passed through the office.

The invaluable series of publications issued by the Smithsonian Institution has done more than anything else to elevate its position in the eyes of foreign savants. Dr. Adler, quoting Dr. Goode, points out that the value of the books distributed since the Institution was opened up to 1895 has been nearly one million dollars, being twice the original bequest of the founder.

Sixty-five pages of the handsome volume are devoted to the 'United States National Museum,' by Mr. Frederick William True, constituting an interesting record of this important department. Its formation from a nucleus contributed by the Patent Office and by the National Institute, its growth through results of explorations, and especially from the International Exhibitions held in 1876 and 1893, are herein described. The educational value of the great collections has been enhanced by the liberality of its Directors in sending duplicate specimens to institutions of learning, and especially by making displays of its treasures at the exhibitions held at London in 1883, Louisville in 1884, Minneapolis in 1887, Madrid in 1892, Chicago in 1893 and Atlanta in 1895. One of the results of

these periodical displays has been the revolutionizing of exhibition methods in the United States. Much space is given to reports of the Curators of the several departments and sections into which the Museum is divided; the larger divisions being as follows: Zoology, Botany, Geology, Anthropology and Arts and Industries. This chapter concludes with an account of the scientific publications of the Museum.

Dr. W J McGee contributes a graphic and vigorous essay on the history, policy and work of the 'Bureau of American Ethnology.' It clearly shows the immense value of the labors of the Bureau in collecting and preserving systematized knowledge of the North American Indians. Major J. W. Powell, the Director, found the science of anthropology young and scarcely developed when he took charge of the enterprise, and was obliged to devise methods of study as well as plans for making collections. The Bureau conducts explorations of mounds, tudies in ethnology, archæology, pictography and linguistics of North America, and publishes four series of works which aggregate more than fifty volumes.

'The Astrophysical Observatory' is treated by its founder and Director, Professor S. P. Langley. The remarkable results accomplished in spite of a very inadequate environment with a small appropriation, first granted by Congress in 1891, testify to the industry and genius of its Director. The application of the spectro-bolometer to the examination of the infra-red spectrum is one of the topics discussed.

The youngest branch of the Smithsonian trunk, the 'National Zoological Park,' is described in a chapter by Dr. Frank Baker. The collection of animals for exhibition as museum specimens was supplemented by a collection of living animals which found temporary quarters in rude sheds behind the Institution building. From this small beginning was evolved the present fine park of 166 acres in a beautifully picturesque situation north of the city. In this park efforts are made to place the animals in congenial situations so that they may feel at home, so to speak. The collection includes herds of buffalo (bison), of llamas, of elk and of deer, as well as some valuable exotic animals. Owing to the insufficient appropriations by Congress this national enterprise has not made the progress hoped for by its founders, but the beginning is a good one.

Mr. Frederick William True writes of the 'Exploration Work of the Smithsonian Institution,' and a biographical sketch of George Brown Goode, by President David Starr Jordan, concludes Part I. of the volume.

The second part of the Memorial contains 'Appreciations of the work of the Smithsonian Institution,' divided as follows: Physics, by Thomas Corwin Mendenhall; Mathematics, by Robert Simpson Woodward; Astronomy, by Edward Singleton Holden; Chemistry, by Marcus Benjamin; Geology and Mineralogy by William North Rice; Meteorology, by Marcus Benjamin; Paleontology, by Edward Drinker Cope; Botany, by William Gilson Farlow; Zoology, by Theodore Gill; Anthropology, by Jesse Walter Fewkes; Geography, by Gardiner Greene Hubbard; and Bibliography, by the present writer. These reviews record the investigations carried on in the special fields named by officers and by those associated with the Institution, as well as the researches that have appeared in its publications. Credit is given to the individuals and to the Smithsonian, without whose aid many of the investigations would not have been undertaken.

Following these 'Appreciations' are three chapters as follows: 'The Cooperation of the Smithsonian Institution with other Institutions of Learning,' by Daniel Coit Gilman; 'The Influence of the Smith-

sonian Institution upon the development of libraries, the organization and work of societies and the publication of scientific literature in the United States,' by John Shaw Billings; 'Relation between the Smithsonian Institution and the Library of Congress,' by Ainsworth Rand Spofford. The mere enumeration of these descriptive titles explains the scope of the articles, and shows how fully the editor, Dr. G. Brown Goode, covered the entire field of the work within the Institution and its contact without during the first half century of its existence. In an appendix William Jones Rhees chronicles in order the principal events in the history of the Smithsonian. A full index closes the volume.

Twenty-four engravings and process-pictures of superior excellence are scattered through the book; they embrace views of the Smithsonian Institution and of the Hodgkins medal, with portraits of Smithson and of many of the Regents. As respects the typography, press-work, paper and binding no pains have been spared to make the book worthy of its subject. A small number of copies were bound in white vellum. For bibliographers the exact title is appended: The Smithsonian Institution, 1846–1896. The History of its First Half Century, Edited by George Brown Goode. City of Washington, 1897. Pp. x+856. Royal 8vo. Illustrated.

H. CARRINGTON BOLTON.

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*THE DIGNITY OF ANALYTICAL WORK.**

IT will doubtless be conceded by all that in the choice of the field to which one proposes to devote his life-work a number of things should be consulted. Among these may be mentioned not only mental capacity and the opportunities for training by courses of study which may be available to him, but also what may be termed natural inclination or love for the work. Just how much work should be given to each of these elements is a query not easily answered, but few will deny that genuine interest in or real love for the field of work chosen should be allowed as great sway as possible. Those of us who have gotten far enough along in our life-work to be able to look back somewhat, and to see and to differentiate the causes that have shaped our line of effort, know full well that circumstances beyond our control, rather than our inclinations and desires, have in many cases determined our course, but the fact nevertheless remains that for the best results, for the attainment of even moderate success, one's efforts must be in an agreeable field and his heart must be in his work. Fortunate is the man for whom circumstances so shape themselves that he is able to pass his years in the field of his choice and spend and be spent in work that is congenial to him.

Assuming now that, for most of us, circumstances and conditions have been such that we are spending our lives in the field of our choice, let us consider, for a moment, a tendency that seems to be a concomitant of those thus fortunately situated. Do we not occasionally find in ourselves a disposition to magnify the importance of the field in which we happen to be engaged? Are we not somewhat inclined, quite naturally perhaps, to think that our field of work is more important than that in which others are occupied? Does not the theoretical chemist, whose inclinations lead him to spend his time in writing reactions and building structural formulæ of wondrous architecture, often feel within himself that his work is on a higher and nobler plane than that of the patient analyst who has furnished the data which he uses? Does not the organic chemist who delights in the study of the carbon compounds, who can

* Presidential address delivered at the Washington meeting of the American Chemical Society, December 29, 1897.

repeat for you series after series of chemical bodies, differing from one another by the constant addition of an element, or group of elements, in whose vocabulary 'types,' 'substitution,' 'replacements,' 'condensations' and 'isomers' are familiar words, and who when a new organic compound is discovered cannot rest until he has found to what series and what place in the series it belongs, or what its relations are to other bodies in that marvelous structure, based on the element carbon, which the studies of the last half century have reared before our eyes—I say does not this organic chemist oftentimes feel that he is engaged in a field far more worthy of study, to which is due much more consideration, than to that of his inorganic brother who devotes days, and perhaps weeks, to unraveling the constitution of some obstinate silicate whose crystalline form gives little help, and whose oxygen ratio is hidden or obscure? Or, again, does not the physical chemist oftentimes think that, with the tools of his more especial field, with his specific heats, his vapor densities, his heat of chemical combination and his ions, he is quite competent to solve all problems worth solving in the realm of chemistry, and that those who are engaged in other lines are far below his standard and can be looked down upon with quite pitying sympathy? Still once more, do we not often see the pure chemist, whose battle cry is 'original work for the work's own sake,' claim for himself the highest seat in the synagogue, and refuse to join his efforts with those of others whom he regards as his humbler brethren, viz., those working in the field of applied chemistry, in securing the benefits of organization to extend and widen the borders of our science? Finally, not to make distinctions, do we not frequently see the analyst, who knows so well how necessary it is to have the trained and skillful hand and the acute and watchful brain both working together and at the same time, in order to secure the accuracy without which his work is worthless, claiming for his field that it is the foundation upon which our science rests, and that those who spend their time in locating the position of an atom in its molecule, or in finding the relations of an organic compound to other members of its series, or perchance in inventing long names for new compounds in which all the resources of the ancient Greek and Latin are brought to bear, to reveal in one word the constitution of the compound—I say does not the analytical chemist often regard these workers as unworthy to be called chemists?

Now, far be it from me to say that this partiality of each for his own field is blameworthy. We can, indeed, conceive of cases in which this partiality may be carried a little too far, but within proper limits not only is it not blameworthy, but even, as it seems to us, it may be praiseworthy for one to magnify the importance of the work in which he is engaged. A just and proper estimate of the value of his own work, a reasonable pride in his chosen science, or in that paddock of his science which it has fallen to the share of each to care for and cultivate, and indeed a moderate, though necessarily a somewhat partial, comparison of himself and his field of labor with others, even though that comparison is somewhat to the detriment of the others, are not always necessarily bad. On the other hand, such pride and such comparisons tend to stimulate to renewed activity, tend to sustain in the perplexities and discouragements of work, and tend to keep one's effort concentrated on the work which he can do best. Looked at in this light, the generous rivalry of one branch of our science with another, or the pardonable pride of each in his own chosen field, and even in his own work, may be a distinct advantage, and I know you will bear with me a few minutes, while I, with proper modesty and in the

true spirit, I hope, try to magnify a little the field of analytical work.

To my mind, then, it is just and proper to take pride in analytical chemistry, because of the power which a properly conceived and executed analysis has of explaining difficulties. A few illustrations will, perhaps, make this point clear, and I am sure I shall be pardoned for giving illustrations from my own experience, rather than historical ones.

Some years ago, after a passenger coach on the Pennsylvania Railroad had been through the hands of the car cleaners, it was noticed by some of the officers that the paint on the outside looked very badly, and had apparently been injured by the cleaning. A careful examination by the paint experts revealed the fact that the varnish was nearly all gone, and in some places the paint itself partially removed. As a matter of discipline, the car cleaners were called to account, and requested to explain why the paint and varnish had been so badly injured. Their reply was that with the soap that was furnished for car cleaning no better results could be obtained. This statement was, of course, received with a grain of allowance, it being well known to railroad operating officers that almost universally when anything goes wrong, and the men are called to an account, the materials are blamed. However, in order to give the men the benefit of the doubt, a sample of the soap was obtained and submitted to analysis, when it was found that this soap actually contained over three per cent. of free caustic soda and about seven per cent. of sodium carbonate. It is evident that this soap had been very carelessly made from cheap materials, and, since it is well known that water solutions of both caustic and carbonated alkalies are fairly good solvents for dried linseed oil and other constituents of paint and varnish, it is clear that the defense of the men, in this case at least, was legitimate and that the soap was really at fault. It may be added, for information, that the circumstances above described led to the preparation of a specification for common soap, in which the amount of free and carbonated alkali was limited to very low figures, and that no similar difficulty of destruction of paint and varnish has since occurred.

Another illustration from a different field will emphasize the power of an analysis to explain difficulties. A lot of boiler-plate was at one time received at the Altoona shops from one of the best makers. In this lot of forty or fifty sheets two were found which gave difficulty in flanging, this operation consisting, as is well known, in bending over the edges of the sheets while hot, nearly at right angles to the balance of the sheet, in order to enable it to be joined to other sheets in the boiler. The two sheets referred to cracked in the bend, although the remainder of the lot gave no difficulty from this cause. The workmen being thoroughly experienced, and the practices of the shop being excellent, the cause of the failure in the case of these two sheets was not apparent. An analysis of samples from each of these sheets, however, showed 0.35 per cent. and 0.36 per cent. of carbon respectively, while analyses of samples from other sheets in the same lot showed in no case above 0.12 to 0.15 per cent. of carbon. The explanation of the difficulty seemed now quite clear. The shops had been supplied for a long time with the softer grade of steel, and the methods and practices in use were those applicable to that kind of steel. No wonder, then, that with the harder grade difficulty should arise, as actually happened, and but for the analysis this might have passed into shop traditions as one of those unexplained and unexplainable crotchets of steel which both the makers and practical users of this metal delight in constantly bringing forward.

A single illustration further will, perhaps, suffice on this head. A few years ago a shipment of some three hundred freight axles was received at two different shops on the Pennsylvania Railroad, from an entirely reputable maker. Some of these axles were used for repairs, and some went under new cars. Scarcely had they gotten into service, however, before difficulty began to arise. The axles began to break. Indeed, one of them broke before the car had been turned out of the shop yard, one broke into three pieces before the car had made 150 miles, and in less than three months eight had broken. Each of the broken axles was sent to the laboratory, and a careful study of the case made, with the hope of discovering the cause of the failure. An examination of the freshly fractured ends of several of the broken axles showed that for a little distance in from the circumference the fractured steel presented an appearance quite different from that given by the remainder of the fracture. Moreover, a line of demarcation between these two apparently different kinds of steel in the same axle could be clearly traced. Accordingly, it was decided to make analysis of borings from near the circumference and near the center, and see whether this would reveal anything. It may be stated that the axles were known to have been made from Bessemer steel, and should normally have contained not more than 0.10 per cent. of phosphorus. The analysis of the borings from near the circumference of the axles in no case gave figures up to this limit, while the borings from the center of the axles in no case showed less than 0.16 per cent. phosphorus, and in some cases the amount was as high as 0.24 per cent. Those who are familiar with the methods in daily use in modern steel works will, from these figures, at once understand the cause of breakage of these axles. For the benefit of those who are not, it may be well to explain that in most modern steel works large ingots are now the rule, and that in large ingots, which take considerable time to solidify from the molten condition, analyses show that some of the constituents of the steel are not uniformly disseminated throughout the mass. This separation of the constituents during cooling, technically known as 'segregation,' is characteristic of the carbon, the phosphorus and the sulphur. Furthermore, the segregation appears to be worst in the upper third of the ingot, so much so that many specifications now require the upper third of the ingot to be removed, and not used at all in making the articles the specifications call for. This much being stated, it is clear why our axles broke. They were made from badly segregated steel, perhaps from the rejected upper thirds of a lot of ingots, the balance of which were used for other purposes. Subsequent correspondence with the parties furnishing the axles gave good grounds for belief that such was the case. For the comfort of those who ride on railroads, it may be added that the 300 axles were at once withdrawn from service, and that since that time a chemical and physical specification for both passenger and freight axles has been prepared which is believed to preclude the possibility of such axles as are described above being received by the Pennsylvania Railroad.

These illustrations of the power of an analysis to explain difficulties could be prolonged to almost any extent, but I spare you. Furthermore, I should not like to be understood as claiming that every puzzle, every difficulty or every state of affairs in nature where the reasons for the phenomena which we find are not apparent at sight can be explained by a chemical analysis. Our knowledge is far too limited for this. Moreover, many cases could be cited in which an analysis throws no light whatever on the situation; but, notwithstanding this, an experience of some twenty

years in seeking out the causes of things, as a necessary preliminary to the intelligent modification of practices and methods in connection with a great corporation, has continually impressed me more and more with the very great help which a properly conceived and executed analysis can give in cases of difficulty.

But, again, I take pride in the field of analytical work, because of the opportunity which thoughtful analytical work affords for finding new things. The careful, thoughtful, observant analyst is constantly on the verge of either being able to add to his own knowledge or of being able to contribute something to the general progress of our science. And here, again, I must be pardoned for using as illustrations cases which have arisen in the laboratory of the Pennsylvania Railroad Company.

A few years ago, in our laboratory, we began to get ready to make our analyses of the samples of steel which were designed ultimately to be the international standards for the analysis of iron and steel. Before starting in on these samples, however, it was deemed prudent to do a little preliminary work on some other samples, with the idea in mind of seeing whether apparatus and method were satisfactory. Accordingly, four separate and distinct determinations on the same sample were made for carbon, using the double chloride of copper and ammonium to release the carbon, and burning in oxygen gas. The four determinations agreed with each other within 0.01 or 0.02 of a per cent., and were regarded as fairly satisfactory. But as the work was important, and as some parts of the apparatus had not worked quite satisfactorily, it was decided to repeat the four determinations. Meanwhile a new stock bottle of solution of the double chloride had been made exactly in the manner that had been our custom for some time previous. When the second four determinations were obtained they differed from the first by more than a tenth of a per cent. I need not weary you with the details of our hunt for the cause of this discrepancy, how every point in the apparatus was tested one after another, how various modifications were tried, how combustions were made on crystallized sugar to check ourselves, and how finally we located the difficulty in the double chloride of copper and ammonium solution. These details have all been published.* Suffice it to say that, as the result of this work, together with subsequent work by other chemists, it is, we believe, now generally accepted that the commercial ammonium double salt contains carbon in some form, probably pyridine, that its use as a solvent to release the carbon from iron and steel is unreliable, and that the substitution of the potassium for the ammonium double salt overcomes these difficulties. The point which I especially want to emphasize is that, in trying to do a little careful analytical work, we struck a new and apparently hitherto unsuspected source of error in one of the oldest and best established methods of iron and steel analysis.

Another illustration will, perhaps, make this point still more clear. In the regular course of work, at one time a silicon determination was made in a piece of tire steel which had been sent by an officer of another railroad for information. The figures found by our analysis were 0.14 per cent., these figures being sent to the officer above referred to. A little later word was received that an analysis of a sample from the same tire by another chemist gave 0.28 per cent. as the content of silicon. This, of course, led us to look over our work, with the idea of finding where the cause of the discrepancy lay. A careful examination of our weights and figures showed that it was not an error of calculation. Accordingly, we decided to duplicate our work, need I

* *Trans. A. I. M. E.*, 19, 614.

say, with the expectation of finding that the other chemist had made a mistake? Judge of our surprise when we found that our second analysis confirmed his figures exactly. Our first and second analyses had been made by the same method, and by the same operator, working on borings from the same bottle, and the cause of the discrepancy between the two was not, therefore, at first sight apparent. On carefully questioning the operator, however, as to exactly what he did at each step of the method, a clew was obtained, which, when followed out, cleared up the whole difficulty and ultimately led to a modification of the method. The silicon in these samples was determined by what is known as Drown's method, which consists in dissolving the steel in nitric acid, adding sulphuric, heating until white fumes of the latter acid appear, to render the silica insoluble, dilution with water, filtration, washing and weighing. The difference between our two analyses consisted simply in this, that in the first case, after the dilution with water, there being considerable work in hand, the vessel was allowed to stand overnight before filtration, while in the second case filtration immediately followed dilution. Subsequent work on this point showed that in this method silica is not completely dehydrated by heating in concentrated sulphuric acid in presence of iron salts, but is apparently rendered colloidal and sufficiently dehydrated, so that if filtration follows soon after dilution fairly accurate results will be obtained. On standing after dilution, however, this colloidal, undehydrated silica, apparently goes into solution again. Indeed, we were able to get on this same sample, anywhere from one-eighth up to the full amount of silicon present, by varying the time of standing after dilution, the longest time covered by our experiments being about four days.

Perhaps I may venture to give you still one more illustration of how, in the course of analytical work, new and apparently hitherto unnoticed reactions may be hit upon and modifications of methods result. Every chemist who has done much work in determining phosphorus in iron or steel, by the reduction of the molybdic acid of the yellow ammonium phosphomolybdate and subsequent titration of the reduced solution, cannot fail to have been annoyed by the occasional failure of duplicates to agree. Apparently, in the two analyses everything has been done exactly alike, and yet the results do not agree. Every thoughtful chemist cannot fail to have felt at such times that somewhere in the method there were conditions affecting the result that were not fully controlled. During the last six or eight months in our laboratory we have apparently struck one of these hitherto uncontrolled conditions, whose influence is not large, and yet enough at times to cause annoying discrepancies in duplicates, or between different chemists working on the same sample.

In order to make clear what follows, it should be stated that in the ordinary working of this method the yellow precipitate, after careful washing, is dissolved in ammonia, and this solution is then treated with sulphuric acid largely in excess and diluted to a definite volume, in which condition it is passed through the reductor and subsequently titrated with standard potassium manganate. The reductor in common use consists, as is well known, of a tube of heavy glass, about five-eighths of an inch internal diameter, and about a foot long, filled with powdered zinc, the top being fitted with a funnel, and the bottom with a stopcock. Below the stopcock a smaller tube carries the rubber cork by means of which the reductor is fitted to the flask which receives the reduced solution. This smaller tube usually projects into the flask an inch or two, and it is customary to

use the pump to draw the liquid through the reductor. This much being premised, we may say that in a communication from Mr. Porter W. Shimer, one of the members of the Sub-Committee on Methods of the Committee on International Standards for the Analysis of Iron and Steel, he, among other things, called attention to the fact that when making a number of determinations on the same sample, all other things being the same, he got a reduced solution that required more permanganate if he prolonged the small tube below the stopcock in the reductor, nearly to the bottom of the flask, than if this small tube projected only an inch or two into the flask. This statement brought afresh to our minds a thought that every one who has worked much with molybdic acid must have had: viz., that reduced molybdic acid is very easily reoxidized. We accordingly determined to find out, if possible, whether this was actually the case, and, if so, how much this difficulty might amount to. Accordingly, a stock solution of ammonia molybdate dissolved in water was prepared, and a number of aliquot parts of this solution measured out. Now, obviously, there are two chances for the reduced solution to become oxidized by exposure to the air. One of these is from the air in the flask during the reduction, and the other from the outside air during the titration. Without going into minute detail, it is, perhaps, sufficient to say that when we reduced an aliquot part of our stock solution, using the short tube of the reductor and adding the permanganate drop by drop, with continual agitation during the whole titration, we used 22.7 cc. of our standard permanganate, all figures given being a mean of a number of closely agreeing determinations. When now we made the reduction the same as before, viz., with the short tube of the reductor, but titrated by allowing about ninety-five per cent. of the permanganate required to run into the flask before agitation at all and finishing the titration drop by drop, we used 23.1 cc. of permanganate; in other words, so sensitive is a reduced solution of molybdic acid that it is easy by varying the mode of titration to introduce considerable error. Prolonging now the tube at the bottom of the reductor as suggested by Shimer, which would result, as is apparent, in a diminished exposure of the reduced solution to the air in the flask before titration, we found our aliquot part to use up 23.6 cc. of permanganate. But even with the prolonged tube there is some exposure of the reduced solution to the air during the reduction. Accordingly, on the suggestion of my principal assistant, Mr. F. N. Pease, we put a measured amount of standard permanganate solution into the flask which was to receive the reduced solution, more than sufficient to react with it, and then prolonged the tube from the reductor, to dip below the surface of this permanganate. Obviously, with this arrangement the reduced solution is entirely prevented from air exposure. On making the reduction and titrating the excess of permanganate with standard solution of ferrous sulphate, it was found that the aliquot part had now used up 24.1 cc. of permanganate, an extreme difference in amount of permanganate used under the varying conditions described, of nearly six per cent. Obviously, if two chemists were working on the same sample of molybdic acid, one employing the manipulation first described, and the other that last described, the discrepancy between them would be serious. The discrepancy on phosphorus in steel, while the same in percentage, is very much smaller in actual figures, but still enough to be annoying. The work above referred to is not yet quite finished, but enough has already been done to demonstrate that the ordinary method of determining phosphorus in steel can be advan-

tageously modified in the interests of greater accuracy; and also, although not yet rigorously demonstrated, there are strong indications that molybdic acid (MoO_3) is always reduced by zinc to Mo_2O_3, and that the more complex formulas, $Mo_{12}O_{19}$, $Mo_{24}O_{37}$, etc., so commonly given as representing this reduction, simply mean that the conditions under which these formulæ were obtained permitted the reoxidation of the reduced solution to the extent indicated.

There is another phase of this question we are discussing: 'The Dignity of Analytical work,' which will, perhaps, bear a few words. It seems to be universally conceded that the brain that plans and guides is worthy of more honor than the hand that executes; the general deserves more than the private soldier; the architect than the builder; the investigator who plans the work than the chemist who makes the analyses. Few will object to such a distribution of rewards as this, and certainly no one will claim that a chemist who, machine-like, simply follows directions, without thought or interest in the matter, can fairly claim recognition for anything more, perhaps, than manipulative skill and honesty. But, on the other hand, it is fair to say that such analysts can truly be called analytical chemists. Does not the genuine analytical chemist embody within himself, not only the capacity of brain to wisely plan his method of attack, to conceive which one of the possible reactions in the case it will be best to employ, but also the requisite manipulative skill, to carry out the line of action decided upon. To my mind, these two things, viz., the brain power necessary to plan the work, together with continual activity of the brain while the work is going on, and the skilled and trained hand requisite to do the work, are necessarily coexistent at the same time in the good analytical chemist, and woe be to that chemist who tries to put them asunder. The analyst whom chance or the exigencies of earning his livelihood have thrown into a situation where day after day he must, for a time at least, do the same thing over and over again, and who does not, even in this situation, use his brain constantly, does not each time he adds a reagent think what is going on in the beaker; does not each time he washes a precipitate think what he is washing out; does not every time he makes a weight take a genuine interest in the result, and even the hundredth time that he makes the same determination is not on the lookout for some flaw in the method he is using, or some possible new reaction in connection with it—such an analyst, I say, will stand a good chance to remain a routine chemist all his life.

On the other hand, what shall we say of those chemists who plan out a line of investigation and are content not to make the necessary analyses themselves? We are quite well aware that at the present time this is a very common method of making investigations, and we can, of course, understand that pressure of other duties may make it impossible to pursue investigations in any other way. But we cannot regard this state of affairs as, to say the least, anything less than unfortunate. If we may trust our own experience, the time spent in making the analyses required by one line of attack on a stubborn problem is most valuable, in the opportunity which it affords for carrying the problem in mind, and planning out other lines, in case the one in hand does not succeed. Moreover, still more valuable is it to make the analyses yourself, in that while doing so you so frequently get suggestions from the work that are the very ones upon which final success depends. I wish there were time to illustrate this point as its importance deserves, but the history of chemistry and your own experience will have to furnish

them to you. To our minds it is hard to overestimate the importance, especially to a young investigator, of his doing his own analytical work for himself. If we read rightly, this was the almost universal habit of the old masters of our science, and we greatly fear that those chemists who from choice delegate their analytical work to others will find, after years of such delegation, that their reward of successful investigations is very small.

A single thought further. At the present time so much applied chemistry is either based on analytical work, or has analytical work as an almost essential constituent of its existence, that in a paper discussing analytical work a few words may not be amiss on the relations between pure and applied chemistry. Without wishing to touch in the slightest degree on mooted or disputed questions, it may not be unfair to say that, while the applied chemist does truly, as the name indicates, in the mass of his work, utilize or apply the discoveries of others to useful effect, it does not at all follow that in the field of applied chemistry no discoveries yet remain to be made. It is certainly not too much to say that no thoughtful chemist has ever worked for any length of time in any field of applied chemistry without finding himself surrounded with problems involving new and unknown reactions; with problems, am I not safe in saying, requiring for their solution as good appliances, as deep study and as keen thought as any that occupy the minds of the pure chemists. These problems continually force themselves upon him, and his only regret in the matter is that the time at his disposal does not permit him to solve them as fast as they arise. A prominent feature of these problems in applied chemistry is worthy of close attention, viz., they generally have immediate useful applications as soon as they are solved. The applied chemist usually makes an excursion into the unknown, because some difficulty has arisen in the course of his regular work, or because some new, more rapid, or more economical method of accomplishing results is desired. He may succeed in finding a new reaction or in utilizing an old one, as the basis of a successful commercial process, or in modifying a manufacturing method in the interests of both economy and speed. But whatever his work, the immediate useful application of the information he secures is both his stimulus and guide. He may not be able, from lack of time, to follow his work up, and find the complete relations of the facts ascertained to the other branches of chemistry, but this is his misfortune rather than his fault, and this condition of affairs, viz., being unable to follow out to completion lines of research one started on is, if we understand the matter rightly, not characteristic of the applied chemist alone. This much being said, let us ask in what respects the pure chemists resemble or differ from those who work in the field of applied chemistry.

They certainly are alike in this, that neither of them can devote his whole time to original work, but both must devote no small portion of their energy to other lines than making investigations. There may have been a time in the history of chemistry when investigators were so fortunately situated that they could devote their whole time and energy to finding out new truth and giving their results to the world. All honor to such investigators. Moreover, we all know that occasionally an appropriation of funds or an endowment is made for research in some special field. But truly, would it not be too much to say that the work of any large percentage of the pure chemists of to-day is the result of any such fortunate circumstances? Furthermore, the pure and applied chemists are alike in that in their original work both

are seeking for the truth, and if they are successful both are adding to the sum of human knowledge.

They differ, as it seems to me, principally in this: First, the researches of the applied chemists being largely made in the interests of corporations or manufacturing establishments, the results of these investigations in many cases are not at once available to the world, except in so far as they lead to diminish cost of production. Those who have paid for these researches naturally feel that they should be allowed a period of time at least to recoup themselves for their expenditures, and so they protect themselves either by patents or secrecy. But this is only a knowledge of the truth deferred. Sooner or later the results of the investigations of all applied chemists are added to the great body of accumulated chemical knowledge. The pure chemist, on the other hand, at once gives the results of his investigations to the world, and is quite content if the publication of his researches shall bring him as his reward a modicum of appreciation from his fellows. Second, in their original work, the pure chemists differ from the applied chemists in the ulterior purpose for which the investigation is undertaken. As has already been stated, the applied chemist usually undertakes an investigation, tries to find new truth with the avowed purpose of at once utilizing this truth as soon as it is found. Not so the pure chemists. The problems which they attack and solve so successfully have no necessary relation to subsequent utility. The truth which they discover and put on record may be found to be useful at some time, but its possible immediate utility or non-utility is not taken into consideration by the pure chemist, either in his choice of a subject for investigation or in the prosecution of his work. The truth for the truth's own sake is his motto and guiding star.

If we have diagnosed the case correctly, then, the principal differences between the pure and the applied chemist are that the latter withholds the results of his work from the world for a period of time, while the former gives his at once, and that the latter is, in his original work, seeking for truth that is useful as soon as it is worked out, while the former neither knows nor cares whether the truth that he discovers is either now or at any future time turned to practical or useful effect. Let me not be misunderstood. I am not attempting to belittle in any sense the work of the pure chemists. They are worthy of all honor and respect. But, on the other hand, I am not at all willing to have the work of the applied chemists made light of, or treated as though it were in an inferior field. To my mind there is no occasion for either to belittle the work of the other. The field of chemistry is so broad, the amount of unoccupied ground in every branch of the science is so great, that there is neither time nor energy for struggling as to who is greatest or who is least, but in whatever line a man's tastes, opportunities or the force of circumstances may lead him, whether as a pure or an applied chemist, whether organic or inorganic, whether theoretical, physical or agricultural, whether analytical or synthetic, provided in his mind at all times the love of truth is above all, and honest work is being done, he is worthy of recognition, honor and respect.

C. B. Dudley.

Altoona.

THE AMERICAN MORPHOLOGICAL SOCIETY.

The eighth annual meeting of the American Morphological Society was held at Cornell University, Ithaca, N. Y., December 28th, 29th and 30th. The following new members were elected: Professor J. H. Comstock, Cornell University; Mr. Ulric Dahlgren, Princeton University; Professor

Pierre Fish, Cornell University; Miss Catharine Foot, Evanston, Ill.; Mrs. S. P. Gage, Cornell University; Professor S. H. Gage, Cornell University; Professor C. W. Hargitt, Syracuse University; Dr. B. F. Kingsbury, Cornell University; Professor E. W. McBride, McGill University; Dr. P. C. Mensch, Ursinus College; and Professor A. D. Morrill, Hamilton College.

The following papers were presented and discussed:

On Reading the Records of Evolution in the Wings of Insects. J. H. COMSTOCK.

THIS was an illustration of a method of taxonomic work outlined by the writer several years ago in an essay entitled 'Evolution and Taxonomy,' where he urged a more constant use of the theory of evolution than is customary in work of this kind. It was suggested that, as the structure of a highly organized animal or plant is too complicated to be understood in detail at once, the student begin with the study of a single organ possessed by the members of the group to be classified, and determine its primitive form and the various ways in which this has been modified. The data thus obtained will aid in making a *provisional* classification of the group, which should be confirmed or corrected by a similar study of other organs.

The illustration given in this paper was an effort to obtain data bearing on the working-out of the phylogeny of the orders of winged insects, by a study of the characters presented by the venation of the wings, the homologies of the *anlagen* of the winged-veins, *i. e.*, the tracheæ that precede them in nymphs or pupæ, were determined, and a hypothetical type representing the arrangement of the tracheæ in the nymph of the stem form of winged insects was figured. It was then shown how this type has been modified in the different lines of descent; in some by a reduction in the number of wing-veins by a coalescence of adjacent veins; in others by the development secondarily of supernumary veins. Each of these processes can be observed by a study of the ontogeny of certain species representing the line of development in which it occurs, and also by a study of allied forms in which it has taken place in varying degrees.

The Records of Evolution in the Wings of Dragon-Flies. J. G. NEEDHAM.

THIS paper furnished a concrete illustration of the method outlined in the preceding one. The adult dragon-fly wing was compared with the typical insect wing and was seen to differ widely from it, but the arrangement of the tracheæ in the budding wing of a young nymph was shown to be nearly that of the type. The development of the complex adult venation was then traced in the development of the tracheæ of the nymph, and it was seen that these tracheæ show what was the primitive condition of every feature of the venation.

The *triangle* was selected for an illustration of the reading of the dragon-fly record, and it was shown that primitively this differed little from an ordinary rectangular oreole, while with the adaptation of it to the bracing of the basal part of the wing every part of it has been modified along certain definite lines, which can be clearly traced. Some of these lines of development were illustrated by series of figures. It is stated that the *triangle* is but one of many correlated wing characters, that specialization has taken place along many different lines, and that almost every wing has preserved in some of its parts a bit of the ancestral record. In conclusion, attention was called to the greater value of conclusions based on a true genealogic study of a single organ than of those based on the mere assortment of characters at large.

Some Grafting Experiments upon Lepidoptera. H. E. CRAMPTON, JR.

THE writer described a series of experiments carried on during the spring of 1897, preliminary to a full series now in progress. The operations were performed on pupæ of the commoner Saturniidæ: *P. cynthia*, *S. cecropia*, *C. promethea* and *T. polyphemus*. They were designed to determine, if possible, besides the coalescence power of fragments or nearly complete pupæ, as well the color effect, if any, of each component upon the other. As shown by Mayer and others, the pigmental colors are produced by the chemical decomposition of the blood in the empty scale cells; and, therefore, if two specifically different forms were coalesced, reciprocal color-effects might be looked for.

Photographs and specimens illustrating the types of operations, as well as some coalesced imagines, were exhibited. The first group of operations included homoplastic and heteroplastic unions in natural proportions of anterior and posterior halves of pupæ. Four out of sixty-one furnished metamorphosed imagines, with the parts perfectly coalesced. A hinder part of the abdomen of a *promethea*, fused to a *cynthia*, showed a buffy color, with no trace of its specific red color.

'Tandem' unions formed the second group. In these, two pupæ, one deprived of its head and the other of the posterior part of its abdomen, were joined. Three out of twenty-seven operations proved successful, producing compounds with four pairs of wings, six pairs of legs, etc. In heteroplastic operations no *definite* abnormal color-effects were observed.

'Twin' unions afforded fourteen pairs of coalesced imagines from a total of sixty-nine operations. Head to head, back to back, tail to tail, and other unions were obtained. No pairs among the heteroplastic operations showed any reciprocal color-effect whatever.

Regeneration in Planaria maculata. T. H. MORGAN.

THE remarkable power of regeneration of Planarians has been known for a long time. The more recent results of Van Duyne and Randolph have added many new facts to those already known. The following account gives a few additional observations and experiments to those previously published. If the planarian (*Planaria maculata*) is cut into cross-pieces all the pieces make new worms unless they be too small. The piece in front of the eyes does not seem to be able to regenerate. Other experiments show that this piece is near the linear limit of size below which a piece does not regenerate. In the more anterior cross-pieces the new pharynx appears near the posterior end of the piece; in the more posterior pieces the new pharynx appears in the middle of the piece, and in the last piece the new pharynx appears in the middle of the old tissue. Longitudinal pieces cut from the side of the worm, generally form new long worms with the pharynx along the line between the old and new tissue, sometimes, however, in the old tissue. The new median line is often along the middle, or a little to one side of the middle, of the old tissue. Not infrequently these long pieces from the side develop differently. They shorten and become crescentic in shape, with the cut edge in the concavity of the crescent. Along the new edge new tissue develops and completely fills up the crescent. This new tissue soon develops into a head, with eyes and brain. The median plane of the new animal is at right angles to that of the original worm. These pieces never elongate, since there is an unbroken ectoderm behind, that originally formed the side of the worm.

Other experiments showed that almost any part of the old tissue had the capacity to form a new pharynx, but the head with

its eyes and brain, etc., never formed out of old tissue, but always from new tissues.

In one case two heads formed on opposite sides of a short cross-piece that had been cut from the middle of the body. The head, therefore, had the normal orientation of the piece, while the other, turned in the opposite direction, had its orientation exactly reversed.

Regeneration and Grafting in Cordylophora. G. LEFEVRE. (Presented by E. A. Andrews.)

THE stems of Cordylophora, when cut in pieces, exhibit the heteromorphic formation of hydranths, as has already been observed in this hydroid.

The cœnosarc regenerates the new hydranth at the cut end by a distinct process of budding, growing out beyond the old perisarc into a knob-like projection which acquires the rudiments of tentacles in from 36 to 48 hours. This is not merely a direct transformation of the tissues of the stem into the body portion of the hydranth unaccompanied by growth, as has been described for other Tubularian hydroids, but the process is in truth a regeneration or new formation.

A piece of stem invariably regenerates a new hydranth at each end, even when lying on the bottom of a dish. Usually a foot is formed when a stem is brought in contact with a solid object, but in several cases it was found that a hydranth arose at the end which was firmly attached to the dish, the hypostome acting as the organ of attachment. This inverted hydranth did not attain to complete development, but it was a distinct hydranth provided with several short tentacles.

Only negative results were obtained from isolated tentacles, as no regeneration took place, the tentacle soon contracting into a rounded mass and dying.

Grafting may be successfully performed on the stems of Cordylophora. When freshly cut pieces are brought into contact, end to end, a firm, complete, permanent union takes place. Ectoderm unites with ectoderm, endoderm with endoderm. There is no polar differentiation in regard to the ability of the stems to fuse with each other, and in the experiments which were made, series of fused pieces were obtained representing all the possible combinations of the two poles. The united stems did not eventually break apart, but remained intact until they finally died *in toto* after several days. At the point of union between two pieces a lateral branch was given off in many cases, each portion apparently contributing equally to the branch.

A Recent Variety of the Flatfish, and its Bearing upon the Question of Discontinuous Variation. H. C. BUMPUS.

IT was shown that within the past five or six years the lower side of the flatfishes (*Pleuronectes Americanus*) from Woods Holl, Narragansett Bay and Long Island Sound has, with great frequency, become deeply pigmented over more or less definite tracts.

The abrupt appearance of a large number of individuals, varying in a definite direction, bears directly upon many current speculations of organic evolution. It was claimed that the variation being so widespread must have been the result of some environmental stimulus upon the germ, since the arrangement of the color precludes the possibility of its being the result of the direct action of light, and there is evidence to prove that the appearance of 'piebald' specimens was not due to the invasion of piebald fish from other localities.

It was also claimed that the process of natural selection could not have been materially instrumental, since the presence of the piebald specimens was first indicated by a large number of young fish, and because the time has been too brief for nat-

ural selection to eliminate either the original type or the new variety. It would, moreover, be illogical to presume that the same agent that has been instrumental in causing the disappearance of the pigment in the natural fish is the same agent, in the same locality, and under apparently the same conditions, that is instrumental in again producing pigment on the lower side.

A Precise Criterion of Species. C. B. Davenport.

In order to decide whether two allied groups are species or varieties it is necessary first to give an exact quantitative expression to the two best criteria of species —divergence and segregation —by the use of the modern mathematical method of studying individual variation. Divergence is the distance between the modes of the two groups in question expressed in units of the average deviation from the mean of the individuals of one of the groups. Segregation is inversely proportional to the number of intergrades, or it is the height of the lowest ordinate between the two modes expressed in units of the height of one of the modes.

An examination of the usage of systematists will tell us what least degree of divergence or segregation is usually expected in distinct species. Leaving the precise determination of this least degree still undecided, we may conclude: A group of allied individuals giving a dimorphic curve of a (differential) character consists of two species either when the minimum between the two groups is m [20] % or less, of the shorter mode, or when their modes diverge by n [10?] or more times the smaller average deviation of the two subgroups. Otherwise the dimorphic curve indicates two races.

Certain Results from a Study of the Variation of Littorina. H. C. Bumpus.

The critical study of variation in 100 specimens of Necturus revealed the fact that those individuals which were abnormal so far as location of the pelvis was concerned were also abnormal in respect to many others, and only remotely related characters; that those individuals which were unstable in respect to one character tended towards instability in respect to all characters; that variation of one organ was an indication of probable variation of other, if not of all, organs. The examination of over 1,700 sparrows' eggs encouraged the belief that this principle of the general instability of variants might be of further application, and in a recent article by Havelock Ellis, on Genius and Stature, it is concluded, on anthropological data alone, that those variations of mind which have been instrumental in producing men of eminence are accompanied by striking and remote physical variations; that those who have attained distinction as warriors, statesmen, scientists or writers have generally been above or below the mean of stature.

The speaker then exhibited 1,000 shells of *Littorina littorea* which had been arranged in order, according to their shape, from extreme elongation to extreme ventricosity, and showed that those at the extremes tended toward excessive variation in weight. Both ventricose and elongated shells were far *heavier* and *lighter* than the species of more ordinary form.

Grafting Experiments on Tadpoles, with Special Reference to the Study of the Growth and Regeneration of the Tail. R. G. Harrison.

The method of grafting amphibian larvæ, as described by Born in his exceedingly original and suggestive paper [Archiv f. Entwicklungsmechanik, Bd. 4], may be applied to the study of the normal growth of the embryo. Thus, when portions of larvæ of *Rana virescens* and *R. palustris* are combined in various ways to form a complete normal organism, the sharp con-

trast in color between the tissues of the two species enables one to follow in the living specimen the exact development of each part. If the tail-bud of an embryo (ca. 4.5 mm. long) of one species be replaced by a similar portion taken from the other, it may be observed that, as the tail grows, the epidermis from the body moves out over the base of the tail until about the end of the sixth day it covers its proximal two-thirds. The underlying tissues (muscle plates, notochord and spinal cord) grow apically, and the place of union between the two portions remains very near to the base of the tail, although it does shift with respect to the anus through a distance equal to about three metameres. When several segments of the body are grafted along with the tail, a similar shifting of the epidermis takes place, though less in amount, and even when the two parts are united in the region of the pronephros there is a slight backward movement. This is brought about largely, if not entirely, by the pulling of the skin due to the enormous growth of the tail as compared with the body. The parallel between the direction and amount of movement of the epidermis during development, and the mode of distribution of the cutaneous nerves in the body and tail of full-grown tadpoles, indicates that each nerve supplies that region of the integument which, at an early stage, was nearest to it.

When, in place of a tail-bud which has been removed, a similar portion of another larva is grafted by its distal end, leaving the proximal end free, a tail-like structure is regenerated. In cases where the notochords of the two parts unite, the regenerated tail attains a degree of perfection but little inferior to those regenerated from the distal end. If the notochords do not unite, regeneration may take place from both pieces, resulting in a forked tail. When neither the notochords nor spinal cords unite, the tail stump of the stock regenerates, while the grafted piece remains as an insignificant lump on the side of the tail.

In all cases (six) where virescens tails were grafted to palustris larvæ, and in fifty per cent. (four) of the cases in which palustris were grafted to virescens larvæ, degeneration of the transplanted tissue took place, beginning sometimes as early as three weeks after operation. This was independent of metamorphosis, having begun before the appearance of the extremities. The tadpoles lived for weeks afterwards with withered tails, without undergoing further metamorphosis.

One specimen in which the two parts were united in the region of the pronephros passed successfully through its metamorphosis. Little or no blending of specific characters could be observed. The head of the frog had the markings of *R. virescens*, while the body and hind legs had those of *R. palustris*.

The Structure and Development of the Excretory Organs in Limulus. W. PATTEN.

THE brick-red gland or coxal gland of *Limulus* has long been regarded as a ductless gland of uncertain significance, but we are now able to demonstrate that it is provided with a duct several millimeters in diameter and three or four inches long.

Its development has also been carefully studied, but the structure described as the developing gland proves to be the developing duct; the embryonic gland was not seen at all.

Naturally, the conclusions as to the significance of this organ based on such foundations can have but little value.

The duct in the adult is so thin-walled that it is not readily seen and is very difficult to dissect. But it may be easily injected with either celloidin or asphalt, the mass filling the duct and penetrating all through the lobes of the gland. Isolation is then effected by corrosion with caustic potash.

The duct runs straight forward along the dorso-lateral margin of the plastron, then back again, and, after many coilings, opens into a large irregular chamber, or end-sac, a remnant of the fifth coelomic cavity, situated in the middle of the posterior nephric lobe. The embryonic nephric duct develops as a tubular outgrowth of the ventral wall of this cavity. Its distal end finally unites with a short ectodermic ingrowth (readily distinguished in the adult), which opens at the base of the fifth leg.

The secretions from the four lobes of the gland are collected by gradually widening anastomosing tubules. Each lobe has many separate openings into the large tubules of the longitudinal stolon. The latter empty into the coelomic space, or end-sac, and from there a single nephric duct carries the secretions to the external opening at the base of the fifth leg.

The glandular portion of the kidney develops from six pairs of segmentally arranged 'anlagen.' Omitting all details, it may be stated that a part of the fifth coelomic cavity persists as the thin-walled chamber, or end-sac, mentioned above.

The other cavities of the thorax break down after producing, by a thickening of their neural walls, paired masses of finely granular cells. These cells become hollow and unite end to end to form irregular groups of anastomosing tubules. The longitudinal tubules of the stolon are formed in a similar manner by the union of outgrowths from each cluster of cells. Many tubes on the periphery of the gland retain this unicellular condition in the adult, but in the center of the lobes and in the longitudinal stolon the nuclei of the tubules have multiplied rapidly, giving rise to a lining endothelium of flattened cells.

The cell masses derived from the walls of the first and sixth coelomic cavities disappear. The remaining ones form the four lobes of the adult kidney.

The kidney of *Limulus* is, therefore, derived from segmentally arranged groups of excretory cells. Each group of cells probably emptied originally into its corresponding coelomic cavity, and from there to the exterior. These separate external openings have now disappeared, and the organs are united by longitudinal tubules which open by a single duct, or coelomic funnel, to the exterior.

I consider the kidney, the nephric duct and the genital duct of *Limulus* homologous, respectively, with the pronephros, the pronephric duct and the Müllerian duct of Vertebrates.

Many of the details of the above account were worked out in the biological laboratory at Dartmouth by Miss Annah P. Hazen. They will be fully described and illustrated in a joint paper that we hope will appear at an early date in the *Journal of Morphology*.

The Reaction of Amœba to Light of Different Colors and to Röntgen Rays. N. R. Harrington and Edward Leaming.

The physiological effect of Röntgen rays upon undifferentiated protoplasm is almost imperceptible as compared with the reaction produced by mechanical stimuli, heat, electricity or light.

We have found that *Amœba proteus* is extremely sensitive to changes in the color of light in which it is placed, and that it exhibits characteristic movements in different light environments.

The remarkably delicate condition of phototonus is, we think, dependent upon a favorable quality of light and an optimum temperature. Continuance in a given color produces a more or less characteristic flow; in violet a spasmodic, unsuccessful attempt to form pseudopods; in green or red a massive, diffuse bodily flow.

A quiescent *Amœba* brought from the room light into red light begins to flow in from ten to twenty-five seconds. The flow

becomes so rapid that photographs exposed one-fiftieth of a second show blurring, due to movement. On changing the red light to violet or mild white, streaming instantly stops and sometimes reverses. Swinging in green, red or yellow screens causes the flow to be resumed after an interval varying in different individuals from an almost imperceptible minimum to ten seconds. The following effect of any color was generally constant after the same preceding color, and as stimulants to flow the colors increased in effectiveness as one approached the red end of the spectrum, while as retarders of flow white light and the colors at the actinic end were most powerful.

The preceding experiments were performed by means of a large photomicrographic apparatus, the image of the *Amœba* being projected by an arc light upon the ground glass back. What little heat there was [24.8° C.] was equalized for the different colors by mica screens. Intensity was eliminated by adding more color screens, which diminished the brightness but seemed to accentuate the characteristic color effect, whether it was a retarding or a stimulating effect.

Stolonization in Autolytus varians. P. C. MENSCH.

As many as eight individual stolons have been observed in single chains of this species. The embryonic segments forming the stolons are derived as outgrowths from the last segment of the *parent stock*, which itself shows internal structures different from those of preceding segments. This process of segment formation contributes three or four segments to the future stolon, the posterior one of the series retaining its embryonic characters and forming the anal segment of the stolon. At the time the anterior of the three or four embryonic segments begin to thicken for the formation of the head a new segment appears anterior to the anal segment, and the future elongation of the stolon takes place by the separation of new segments from the anal segment.

The separation of the stolon takes place in a region of embryonic tissue which does not form part of a true segment, but which is derived from the undifferentiated tissues of the anal segment.

A wide range in the position of the chain exists in this species. In young specimens the chain is as far forward as the 19th segment of the parent stock, while in older and larger specimens it is placed as far posterior as the 59th segment, certain characters in the embryonic region of the chain indicating that, besides being active in the formation of stolons, this region also adds segments to the parent stock.

The cycle of stolonization in this species is: (1) The development of a first stolon on the young asexual individual by a process akin to fission. (2) The development of a chain of stolons from the last segment of the parent stock by budding. (3) The development of possibly a single stolon posterior to the middle region of the parent stock by true fission.

The Use of the Centrifuge for Collecting Plankton. G. W. FIELD.

HENSEN'S counting method is the present basis of quantitative and qualitative Plankton determinations. Yet improvements are desirable and feasible. The desideratum is a practical, rapid, simple method capable of general application, by which data can be obtained for use in determining the comparative economic value of all waters, either for scientific agriculture or for municipal water supplies. Counting of individuals and enumeration of species seem to be necessary, together with an accurate estimation of the volume of the inorganic matter and of the organic amorphous débris.

The chemical determination of the amount

of aluminoid ammonia is practically worthless on account of the organic débris.

The main difficulty in the various methods seems to rest in the manner of collecting the Plankton. The Hensen net and its method of use are open to objections, and filtration methods vary widely in their accuracy and results. Experiments carried on at the marine laboratory of the Rhode Island Agricultural Experiment Station seem to show that the collection and determination of Plankton by a centrifuge is a very rapid and accurate method, and that the results read volumetrically on the graduated glass collector are of value when taken in connection with the nature of the material collected. The total percentage of Planktonts obtained and their condition, especially of the most delicate forms, far surpasses any other method known to me. The work has been carried on with the Plantonokrit, designed and described by Dr. C. S. Dolley (Proc. Acad. Nat. Sci., Phila., May, 1896). The machine acts upon a fixed quantity of water (2 cans, each of 1 litre capacity). Nearly two years' work with the method have given results sufficient to warrant continued experiments.

Note on Ascidian Anatomy. M. M. Metcalf.

Neural gland.—A neural gland is present in all groups of Tunicates, including *Appendiculariæ*, *Salpidæ*, *Octacnemus*.

Its position.—In *Appendiculariæ*, dorsal; in *Simple Ascidians*, dorso-lateral (*Molgulidæ*), dorsal (*Cynthiidæ*) or ventral; in *Compound Ascidians*, dorsal (*Botryllidæ*) or ventral; ventral in *Doliolidæ*, *Pyrosomidæ*, *Salpidæ* and *Octacnemus*.

Its size.—Insignificant in *Appendicularia*; in *Ascidians* varies from a minute and nearly functionless gland to a size fifteen times as large as the ganglion; in *Pyrosoma* and *Salpa* small; in *Doliolum* equal to the ganglion.

Many *Simple Ascidians* have the gland prolonged into the dorsal raphe, *i. e.*, into the median portion of the pharyngeo-cloacal septum. In most of these species merely the duct of the gland is so prolonged; in other forms the raphe contains much glandular tissue in connection with the duct.

In some species of *Simple* and *Compound Ascidians* the tissue of the gland is continuous with the cellular area of the ganglion, recalling the way in which they both are formed from a common structure, the visceral region of the larval neural tube. This origin of the gland from the neural tube (as described by Julin) is readily demonstrated in *Molgula Manhattensis* and in *Ecteinascidia turbinata*.

In all species studied the secretion of the gland is formed by the degeneration and disintegration of cells proliferated from the walls of the duct or its branches. It is, therefore, extremely doubtful if the gland has any renal function. No concretions were found.

The condition of the gland is very different in different species. The divergence affects its size, position and shape. Portions present in one species may be absent in another species of the same genus. The homology of the gland in *Salpa* with that of the *Ascidians* is doubtful.

Function of ciliated funnel.—It is not merely the aperture of the duct of the gland, for (1) it is often not connected with the gland, though well developed (*e. g.*, *Salpa*), and (2) it has a rich innervation in several species of *Simple Ascidians* and apparently in some *Salpas*. In some species, at least, it is probably a sense organ.

The intersiphonal organs of Tunicates show a remarkable asymmetry. Assuming the sagittal plane of the ganglion to coincide with that of the whole animal, the funnel is on the right side, and so also is often the whole or a part of the gland.

In *Molgula Manhattensis* there is a great semilunar fold of ectoderm that pushes into the cloaca parallel to the pharyngeo-cloacal

septum, serving to support the latter and also to support the oviducts.

G. H. PARKER,
Secretary.

HARVARD UNIVERSITY.

(*To be concluded.*)

CURRENT NOTES ON PHYSIOGRAPHY.

DRAINAGE OF SOUTHERN OHIO.

THE greater part of the Allegheny plateau and its westward slope is drained by streams of the simplest kind, dissecting horizontal strata in irregularly branching valleys. But for some years aberrant valley forms have been recognized in the upper Ohio region, special attention having been given to their meaning by W. G. Tight in his latest article on 'Some preglacial drainage features of southern Ohio' (Bull. Scient. Lab. Denison Univ., IX., 1897, 22–32). Confirmation is given to earlier views as to the composite origin of the modern Ohio. The preglacial drainage of the region led the Kanawha (via Teazes Valley), Big Sandy and other streams northward, across the present Ohio Valley, to a common trunk near Waverly. By some process not specified, the Ohio was given a course across the middle of this earlier system, deepening the older valleys for part of the distance, and elsewhere trenching across the divides at the lowest cols. The trenched cols, where the Ohio Valley is narrow and steep-walled, occur below Vanceburg, just above Portsmouth and above Guyandotte. Leverett appends a brief account of his contribution to this problem (l. c., 18–21).

THE COASTAL PLAIN OF MEXICO.

STUDIES by J. W. Spencer ('Great changes of level in Mexico and the inter-oceanic connections;' Bull. Geol. Soc. Amer., IX., 1897, 13–34) give, among other matters, an account of the coastal plain, or *tierra caliente*, that fronts the Mexican plateaus on the Gulf side. It has a breadth of fifty miles back of Vera Cruz, reaching an elevation of 1,560 feet at the inner margin, where the plateau ascends boldly thousands of feet above it. The inclined surface of the plain has not a uniform rise, but is made up of a number of steps or terraces, 50 to 100 feet high, with sloping plains between them. Streams descend from the plateau in valleys having a succession of reaches and falls; the same streams trench their way across the coastal plain. A brief account is given of the 'Geological Canal of Chivela,' on the divide of the Isthmus of Tehuantepec, 776 feet above the sea; its floor having lately been swept over the ocean currents during a depressed attitude of the region.

MOUNTAIN STRUCTURES OF PENNSYLVANIA.

THE prevalent belief in the frequent occurrence of synclinal ridges in denuded mountain ranges is discussed by A. P. Chittenden (Bull. Amer. Geogr. Soc., XXIX., 1897, 175–180), who cites the opinions of a number of authors on the matter. After showing that there is no logical reason to expect the more frequent occurrence of synclinal than of anticlinal ridges in ancient, deeply dissected mountains, the Appalachian ridges of Pennsylvania are classified and measured in three groups, monoclinal, anticlinal and synclinal; the total lengths for each group being 1,333, 334 and 245 miles. Synclinal ridges are, therefore, exceptional; the length of the monoclinal ridges far exceeding that of the other two classes. Synclinal ridges of Pottsville conglomerate in the anthracite coal regions are relatively more common than elsewhere, but even there the monoclinal ridge prevails. The synclinal valley between two neighboring monoclinal ridges often has a high-level floor, but it is surmounted and enclosed so distinctly by two ridges that the three forms cannot properly be described as a single synclinal mountain.

YOUNG, MATURE AND OLD LAND FORMS.

THE use of age-terms suggestive of sys-

tematic changes in the form of the land with the passage of time has come to be generally accepted as a means of geographical description, but not with entire agreement by all writers. One of the first illustrations of this good fashion was in an account of the driftless region of Wisconsin, in which 'topographic old age' was applied to the beautifully dissected hills of the driftless area, where an abundant and varied relief still survives. This would seem to exclude such a term as 'mature,' and to leave no appropriate term for a plain of complete denudation. In another paper the Alps are cited as 'young' mountains, denudation having there progressed 'only far enough to sculpture into very rugged relief the strata of varying hardness.' This would seem to underestimate the enormous amount of destructive work done in the Alps, and to imply that their deformation began not very long ago. Indeed, if 'young' is to be applied geographically to mountain ranges like the Alps, thoroughly dissected by adjusted valleys, some other term than 'young' would be needed for the moderately denuded Jura, or for the still less denuded lava blocks of southern Oregon. It is hardly advisable to increase the series of age terms very far, although infantile, young, youthful, adolescent, mature, decadent, senile and old have all been more or less used. Young, mature and old, with qualifying adverbs, should at any rate suffice for elementary descriptions; and in such a series both the dissected uplands of the driftless area of Wisconsin and the vigorous peaks and valleys of the Alps should be called 'mature.'

W. M. Davis.

CURRENT NOTES ON ANTHROPOLOGY.

RACIAL SOCIOLOGY OF EUROPE.

An interesting review of the researches of Lapouge and Ammon on the above subject is presented by Carlos C. Closson in the *American Journal of Sociology* for November last. The principal racial criterion, the sole one, indeed, is assumed to be the shape of the skull, and particularly of the cranial index. Dividing the area of France into the most dolichocephalic and the most brachycephalic departments, the sociological comparison shows that the dolichocephalic elements excel, not simply in the ownership of wealth, but still more in wealth-producing capacity, and most of all in commercial and financial activity. The dolichocephalic departments pay the most taxes, are more densely populated, richer and generally flourishing. They owe more money and own more bicycles. They also travel more to the cities in larger numbers.

Both Lapouge and Closson accept these results as in some way the consequences of dolichocephaly; but another view, not discussed by either, is that this form of skull is less a cause than a consequence. The studies of the late Dr. Harrison Allen on Hawaiian skulls, now in process of publication, will show that improved conditions of life profoundly modify the cranial form within the limits of the race.

THE DOOM OF THE AMERICANS.

An able and profound study of the birth rate in Massachusetts is given by Arsene Dumont in the *Journal* de la Société de Statistique de Paris, November, 1897. He shows by incontrovertible data that the marriages among the 'American born' in that State and in surrounding parts of New England reveal a steady diminution in the birth rate. This is not new. It has been emphasized by several of our own statisticians. But what is new is M. Dumont's study of its causes.

He finds its chief cause in the principle of democracy. This develops individualism, the overpowering desire of each to live his own life to the best personal advantage, to get all the good there is going, be it in the

sphere of intellect or of other gratification. But the numerical increase of the race is and must be inversely to the effort of the individual to develop himself personally. Republican civilization, he claims, contains a toxic principle. The more intense and general it becomes in a community, the more acute becomes individualism, and this will finally destroy the race and its culture. There may, however, be a democracy directed by science which can escape this poison. With this cheering but vague intimation the article closes.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

PRESIDENT MCKINLEY has, as had been feared, nominated the person from Martinsburg, W. Va., named Bowers for United States Fish Commissioner. Efforts should still be made to prevent confirmation by the Senate, but that talkative body has no time to listen, and only irrelevant accidents are likely to intervene. It is within the limits of possibility that a man chosen by lot from a penitentiary would make a better chief executive than the present 'incumbrance,' and it is quite possible that Mr. Bowers may become a competent Fish Commissioner. His record should not be prejudged and he should be given all possible assistance by men of science. No subsequent events can, however, excuse Mr. McKinley. Those having knowledge of his flabby character will not be surprised when he does a weak and foolish thing, but it is humiliating to know that the President of the United States can deliberately and with full knowledge perform an illegal act.

AT the annual public meeting of the Paris Academy of Sciences held on January 10th the numerous prizes in the gift of the Academy were awarded. Among these we may mention, in addition to the *Cuvier* prize of 1,500 francs awarded to Professor Marsh, and the *Lalande* prize of 540 francs awarded to Professor Perrine, previously announced in SCIENCE, the *Poucelet* prize of 2,000 francs awarded to M. R. Liouville for his work in mathematics and mechanics, the three *La Caze* prizes of 10,000 francs each, in physics, to Professor P. Lenard for his researches on the cathode rays, in chemistry to M. Paul Sabatier for his chemical researches, and in physiology to Professor Röntgen for his researches on the properties of X-rays and their application in therapeutics; the *Parkin* prize of 3,400 francs to Professor Augustus Waller for his researches on the effects produced by certain gases and vapors on the nerves, the *Grand prix des sciences physiques* of 3,000 francs to M. Joseph Vallot, founder of the observatory near the summit of Mt. Blanc, for his researches on the conditions of animal and vegetable life in high altitudes; and the *Petit d'Ormoy* prize to the late M. Tisserand for his researches, and especially for the *Traité de mécanique céleste.*

IT is stated in *Nature* that the Council of the Royal Astronomical Society have awarded the gold medal of the Society for this year to Mr. W. F. Denning, 'for his meteoric observations, his cometary discoveries and other astronomical work.'

IT is reported that a prize of $10,000 is offered by the Belgian government for the discovery of a chemical that will take the place of phosphorus in the manufacture of matches.

THE U. S. National Museum has recently received, by bequest, the 'I. H. Harris Collection,' composed of fossils and archæological material. Mr. Harris, a graduate of Yale in 1846, was born in Waynesville, Ohio. This village, like many other settlements in southwestern Ohio, is situated upon the Cincinnati formation, widely known for its abundant and well preserved Lower Silurian fossils. These attracted his attention about 1846, and up to his death, last October, Mr. Harris was constantly in search of new or better preserved material. The collection has more than 20,000 specimens, of which about one-third are prehistoric stone implements. Many of the latter are from the vicinity of the interesting locality, Fort Ancient, a short distance south of Waynesville. Crinoids, trilobites and starfishes are the distinguishing characteristics of this collection. Other Cincinnati group fossils are also well represented, par-

ticularly brachiopods and mollusca. This is the second large collection of fossils which has been given to the U. S. National Museum during the past five years, the other being the 'R. D. Lacoe Collection' of fossil plants.

Dr. Thomas Egleston, emeritus professor of mineralogy and metallurgy at Columbia University, has presented the government of France with the sum of $5,000, in aid of the mineralogical collection of the School of Mines at Paris, from which he graduated in 1860.

The will of the late Andrew M. Moore, of Philadelphia, bequeaths his entire estate, estimated at $5,000,000, to his three sons, to be held in trust during their lifetime. On the death of the last surviving son the trustees are empowered 'to found and maintain such charitable or educational institution or establishment in my name as they desire or may deem wise or proper.' Directions are also given that the charities to be founded shall be absolutely non-sectarian.

We learn from the *Philadelphia Medical Journal* that the Second Quinquennial Prize of one thousand dollars under the will of the late Samuel D. Gross, M. D., will be awarded on January 1, 1900. The conditions annexed by the testator are that the prize 'shall be awarded every five years to the writer of the best original essay, not exceeding one hundred and fifty printed pages octavo, in length, illustrative of some subject in Surgical Pathology or Surgical Practice, founded upon original investigations, the candidates for the prize to be American citizens.' The prize essay must subsequently be published in book form and one copy of the work deposited in the Samuel D. Gross Library of the Philadelphia Academy of Surgery. The essays, which must be written by a single author in the English language, should be sent to Dr. J. Ewing Mears, 1429 Walnut street, Philadelphia, before January 1, 1900. Each essay must be distinguished by a motto, and accompanied by a sealed envelope bearing the same motto, and containing the name and address of the writer. No envelope will be opened except that which accompanies the successful essay.

We regret to record the death of Dr. Eduard Wiederhold, the chemist, of Cassel, on January the 11th, and of Jean Linden, the botanist, in Brussels, on January 12th, aged eighty-one years.

Professor F. B. Crocker, of Columbia University, President of the American Institute of Electrical Engineers, has accepted the position of consulting engineer of the Electrical Exhibition to be held in Madison Garden, New York, next May.

We learn from the *Lancet* that a meeting of the local executive committee of the British Association was held in Bristol on January 10th. It was mentioned that between £3,000 and £4,000 will be required in connection with the forthcoming meeting of the Association in Bristol, and the Mayor is sending out an appeal to the citizens for this amount. Arrangements are being made for the proposed Biological Exhibition. Several excursions have been planned, among these being visits to Bath, where the Mayor and citizens will entertain the visitors; to Aust, Tortworth, where Lord Ducie will entertain a party; to the Severn Tunnel, Stanton Drew, Cheddar, Glastonbury, Stonehenge, Salisbury, Longleat, Raglan Castle, etc. There are also committees at Montreal and Toronto (at the former city Dr. Bovey and at the latter Dr. Macallum are the Honorary Secretaries), and it is expected that a considerable number of Canadian visitors will be present at the meeting.

At the monthly general meeting of the Zoological Society of London held on January 20th it was reported that the total number of visitors to the Society's gardens during the year 1897 had been 717,755, showing an increase of 52,751 over that of the previous year. The amount of money received at the gates during the year was £17,261, being nearly £1,600 more than the total amount received in the year 1896.

An International Photographic Exhibition, to be held at the Crystal Palace, Sydenham, from April 27th to May 14th, is announced in the English papers. The Exhibition, which will be held under the auspices of the Royal Photographic Society, will be divided into eight sections: (1) history of photography; (2) pictorial photography; (3) portraiture and general

technical photography; (4) apparatus and material; (5) photo-mechanical processes; (6) scientific applications of photography (including medical photography and the application of the X-rays); (7) photography in color; (8) photography as a science. With such an excellent and comprehensive program in view, the success of the enterprise should be guaranteed. Further particulars can be obtained from the Secretary of the Royal Photographic Society at 12 Hanover Square, London, W.

AT the annual meeting of the Indiana Academy of Sciences, held on December 29th and 30th, the President, Professor Thomas Gray, of Rose Polytechnic Institute, delivered an address on 'The Development of Electrical Science.' A full program of 80 papers was presented. These were distributed as follows: General subjects, 9; mathematical and physical, 17; botanical, including bacteriological, 15; chemical, 8; zoological, 20; geological, 11. The following officers were elected for the year 1898: President, C. A. Waldo, Purdue University; Vice-President, C. H. Eigenmann, Indiana University; Secretaries, John S. Wright, Indianapolis; A. J. Bigney, Moore's Hill College; Geo. W. Benton, Indianapolis; Treasurer, J. T. Scovell, Terre Haute. The volume of the Proceedings of the Academy is a public document, a limited number being printed by the State. Copies are distributed under the direction of the Academy.

THE first annual meeting of the Audubon Society of the District of Columbia was held at the Columbian University, Washington, on January 31st, under the presidency of Surgeon-General George M. Sternberg.

PROFESSOR W. B. SCOTT, of Princeton University, read before the American Philosophical Society, of Philadelphia, on February 4th, a paper on 'The Exploration of Patagonia,' giving the results of the Princeton expedition of 1896–97, under the direction of Mr. J. B. Hatcher.

AT the meeting of the Council of the British Medical Association on January 19th, Dr. Dawson Williams, assistant editor of the *British Medical Journal*, who has been connected with the editorial department of the *Journal* for seventeen years, was unanimously appointed editor. At the same time Mr. C. Louis Taylor, who has been sub-editor for the last eleven years, was appointed assistant editor.

DR. H. C. WOOD, of Philadelphia, has accepted the editorship of the *American Medico-Surgical Bulletin*.

THE bill advocated by the State Medical Society regarding expert testimony was introduced in the Assembly at Albany, on January 31st, by Mr. Kelsey. According to the reports given in the daily papers the bill provides that upon the trial of all indictments for felonies, whenever it is made to appear to the Court that the trial of issues will probably require the introduction of medical expert testimony, the Court may, upon application of either party, appoint such number of experts as the Court shall deem proper, not less than three nor more than five. Such experts shall be persons skilled in medical or surgical science, or in both, and shall be duly admittted to the practice of medicine in the State of New York; but in special and extraordinary cases the Court may appoint experts living in other States. Such expert witnesses shall receive such compensation as the Court shall prescribe, which shall not be less than $10 nor more than $100 a day, while in actual attendance upon the trial, which shall be paid by the county. The expert witnesses may be examined and cross-examined in the same manner and subject to the same rules as other expert witnesses; and if, on preliminary cross-examination at the trial with reference to his qualifications, it shall appear that any such witness has, either before or after his appointment, expressed an opinion as to the merits of the action, his appointment shall be revoked and he shall receive no compensation as an expert, but he shall not, therefore, be prevented from testifying as a witness. The party applying for the appointment of expert witnesses is not to be bound by the testimony of such witnesses, but may rebut the same by counter testimony. The act is not to be construed to limit or affect the right of either party to summon other expert witnesses.

SENATOR VEST, from the Senate Committee on Public Health, has made a report on the

bill providing for the creation of a department of public health. The report is adverse to the proposition, and it recommends, as a substitute, the bill for the enlargement of the powers of the Marine Hospital service by giving the President, through this service, the right to resort to measures to prevent the spread of contagious diseases from one State to another.

Secretary Bliss has sent to the Public Land Committees of the Senate and House a bill prepared by Colonel Young, the acting Superintendent of the Yellowstone National Park, for an extension of the limits of that reservation by about 3,000 square miles.

President Skirm has introduced in the Senate of New Jersey a bill entitled 'An act to prevent the introduction into and spread of injurious insects in New Jersey, and to provide a method for compelling their destruction.' The bill has the endorsement of the State Board of Agriculture.

Professor Alfred C. Haddon contributes to the issue of *Nature* for January 20th an account of the plans for a proposed Cambridge Expedition to Torres Straits and Borneo. A committee of members of the University of Cambridge is acting in cooperation with Professor Haddon, and part of the cost of the expedition will be defrayed by a grant from the Worts' Fund, which is administered by the University. The expedition will be almost entirely anthropological in character, but the land flora and fauna will not be neglected, and certain geographical observations will also be made. Its main object is to continue and, as far as practicable, complete the earlier observations made in Torres Straits; but, for the sake of comparison, it is hoped that observations will be made on Australians, Papuans, Melanesians and Polynesians, as opportunities present themselves. After spending a few months in the Straits a short visit will be paid to the mainland of New Guinea, in order to trace the relationship of the islanders. In addition to Professor Haddon the members of the expedition are Dr. W. McDougall, Fellow of St. John's College, Cambridge, and of St. Thomas Hospital, London; Dr. C. S. Myers, Caius College, Cambridge, and St. Bartholomew's Hospital, London; Mr. S. H. Ray, Dr. W. H. R. Rivers, St. John's College, Cambridge, lecturer on experimental psychology at Cambridge and at University College, London; Dr. C. G. Seligmann, of St. Thomas's Hospital, and Mr. A. Wilkin, of King's College, Cambridge. In describing the work assigned to each member of the party Professor Haddon writes: Drs. Rivers, McDougall and Myers will initiate a new departure in practical anthropology by studying comparative experimental psychology in the field. They will test the senses and sensibility of the natives as far as it will be possible under the local conditions, and make whatever observations they can on the mental processes of the natives. Besides the ordinary instruments for anthropometry, there will be a small, carefully selected collection of apparatus for experimental psychology. Two mechanical phonographs will be taken to record the native songs, music and languages. There will also be a complete photographic equipment, including a cinematograph for reproducing native dances, ceremonies and certain characteristic actions. At the close of the article Professor Haddon expresses his willingness to make any special inquiries that any ethnologist may require. The expedition will start about March 2d, and will return early in the summer of 1899.

It is reported in the New York *Evening Post* that, at a recent meeting of the Quebec Geographical Society, Capt. Bernier explained his proposal for the discovery of the north pole. He plans to go by ship to the point north of Siberia where Nansen's vessel, the Fram, crossed the eightieth parallel of latitude. Here he intends to leave the vessel and take to the ice, with eight men, fifty dogs and fifty reindeer, carrying 36,000 pounds of provisions, for two years. He will also have sleds, kyacks and a portable boat made of aluminum and wood. By crossing the ice-floes he expects to reach the pole from the vessel in a little over a hundred days, afterwards making for Spitzbergen or Franz Josef Land. Capt. Bernier is applying to the government for assistance, and his demand will be supported by the Society, which adopted a resolution to that effect. He proposes to proceed by Bering Sea,

starting in June from Victoria, B. C.; he will reach the Siberian islands by September.

THE London *Times*, quoting the *Turkestan Gazette*, announces the arrival at Tashkent of two German professors, whose names are not given, for the purpose of fitting out a scientific expedition to Tibet and Kashgar, in which the Grand Duke of Baden has interested himself. The Russian authorities are giving every assistance, and the party will start from Osh with an escort of Cossacks.

IN commenting on the epidemic of plague in India the *Lancet* states that it has apparently gained such a hold that its proportions in the affected districts are calculated to give rise to serious alarm. The latest reports from Bombay quite bear out this view. The epidemic in that city has been greatly aggravated of late; the type of the disease is of a more virulent character than that of last year, and the mortality is reported to average more than 200 daily. It is scarcely necessary to add that trade is paralyzed, and that there is a renewed exodus of natives from Bombay. The disease also largely prevails in Poona and in the Deccan.

THE Annual Horticultural and Agricultural Exhibition at Cairo was opened on January 14th. According to the report in the London *Times* the exhibits of timber-woods showed the great capabilities of Egyptian soil and climate for their production, and the Finance Ministry is now making experiments in forestry on a considerable scale, and planting out 190,000 young trees of about 100 varieties, all exotic and chiefly from India. A novelty was seen in a substance called cerosie, of which a French local chemist claims to be the discoverer. It is extracted from the scum which rises to the surface of liquid sugar after the cane is crushed. The resulting substance is stated to possess the qualities of ordinary beeswax, which it resembles in appearance, though darker in color.

AT a recent meeting of the British Ornithologists' Club, the Chairman, Mr. P. L. Sclater, F.R.S., gave an account of ornithological journals, giving a history and description of the three principal journals—the *Journal für Ornithologie*, founded in 1853 by Dr. Jean Cabanis and becoming in 1894 the organ of the Deutsche Ornithologischen Gesellschaft; *The Ibis*, founded by the British Ornithologists' Union in 1859; and *The Auk*, established by the American Ornithologists' Union in 1884 and edited by Dr. J. A. Allen. There are, it appears, five ornithological journals in Germany, three in Great Britain, two in Austria, two in America, one in Hungary and one in Italy. There is none in France.

ACCORDING to *Industries and Iron*, the 'Crane' carried out at Portsmouth on the 26th of November her second three hours' speed trial, at which she was required to maintain a mean of 6,000 h.p. and a speed of 20 knots. The mean h.p. of the three hours was, however, 6,267, and the speed 30.347 knots. The revolutions were 397.4. During the six runs on the measured mile the h.p. gave a mean of 6,480, the speed being 30.724 knots, and the revolutions 404½. The mean air pressure for the entire run was 3 in. At the first three hours' trial the coal consumption, which was required not to exceed 2½ lb. per unit of power per hour, has been ascertained to have been 2.4 lb.

A PROPOSAL was made some time ago for the introduction of the seeds of certain trees from India and Ceylon into British Central Africa for the purpose of supplying shade for the coffee plants in the numerous plantations which are now being opened up in the protectorate. The Foreign Office, says the London *Times*, requested Mr. Thiselton-Dyer, the Director of Kew Gardens, to report on the subject. As a result of Mr. Thiselton-Dyer's reports, her Majesty's Commissioner has determined to rigidly enforce the regulations for the prevention of coffee disease in Central Africa, which prohibit the importation of seeds from India and Ceylon. In his report Mr. Thiselton-Dyer says: "The coffee disease was introduced into Fiji through the instrumentality of tea seeds from Ceylon. Notwithstanding the splendid attempts of Sir William MacGregor to stamp it out, it ultimately completely destroyed the coffee industry, which was the most promising planting enterprise in the colony. The Germans, by some unknown means, have succeeded in introducing the disease into their African territories. In the face of these undoubted facts, it would, in my

opinion, be the height of folly to run the smallest risk of introducing the disease into British Central Africa, where its presence would be an irreparable disaster. Knowing the mechanical way in which such work is carried out by native officials in India, I do not think that any stipulation as to locality is of the smallest value. Whatever was stated to the contrary, the first parcel of seed would, in all probability, come from a plantation reeking with disease. The present request is the more unnecessary as, according to a coffee planter in Nyassaland who is well acquainted with coffee cultivation in Ceylon, a local African tree, *Albizza fastigiata*, is admirably adapted for a shade tree for coffee. If this is not sufficient, the rain tree, *Pithecolobium saman*, might be tried. The seed can be obtained in abundance from Jamaica, and this would be perfectly safe."

Messrs. G. P. Putnam's Sons will begin early in the present year the publication of a new series of scientific books, 'The Science Series,' edited by Professor J. McKeen Cattell, Columbia University, with the cooperation of Frank Evers Beddard, Esq., F. R. S., in Great Britain. It is expected that the following will be among the earlier volumes to be in readiness:

The Stars. By Professor Simon Newcomb, U. S. N., Nautical Almanac Office and Johns Hopkins University.

The Earth as a Planet. By Professor C. A. Young, Princeton University.

The Measurement of the Earth. By President T. C. Mendenhall, Worcester Polytechnic Institute, formerly Superintendent of the U. S. Coast and Geodetic Survey.

Earth Structure. By Professor James Geikie, F.R.S., University of Edinburgh.

Volcanoes. By Professor T. G. Bonney, F.R.S., University College, London.

Earthquakes. By Major C. E. Dutton, U. S. A.

Physiography: The Forms of the Land. By Professor W. M. Davis, Harvard University.

The Groundwork of Science. By Dr. St. George Mivart, F. R. S., Chilworth, Surrey.

The History of Science. By C. S. Pierce, Milford, Pa.

The Study of Man. By Professor A. C. Haddon, Royal College of Science, Dublin.

General Ethnography. By Professor Daniel G. Brinton, University of Pennsylvania.

Recent Theories of Evolution. By J. Mark Baldwin, Princeton University.

The Animal Ovum. By F. E. Beddard, F. R. S., Zoological Society, London.

The Reproduction of Living Things. By Professor Marcus Hartog, Queen's College, Cork.

The Structure of Man. By A. Keith.

Heredity. By J. Arthur Thomson, School of Medicine, Edinburgh.

Life Areas of North America: A Study in the Distribution of Animals and Plants. By Dr. C. Hart Merriam, Chief of the Biological Survey, U. S. Department of Agriculture.

Age, Growth, Sex and Death. By Professor Charles S. Minot, Harvard Medical School.

UNIVERSITY AND EDUCATIONAL NEWS.

The sum of $50,000, necessary to secure a gift of $10,000 from the Baptist Educational Society of America, has been raised by subscription for Colby University. It is stated that this money will be in part used for the erection of a chemical laboratory.

The attempt to break the will of William Sauser, of Hannibal, Mo., who died in 1892 and bequeathed all his property, valued at $200,000, to Westminster College, Hannibal, Mo., a Presbyterian institution, has failed.

The Town Council of Aberdeen has voted £5,000 to the University buildings extension scheme, on condition that the same be completed.

At the meeting of the Edinburgh University Court on January 17th intimation was made of a donation of £1,000 by Sir William Overend Priestley, M.P., for the Universities of St. Andrews and Edinburgh. The very Rev. Dr. William Charles Lake, late Dean of Durham, has bequeathed £1,000 to the Durham College of Science, at Newcastle-on-Tyne.

The Geological Laboratory of King's College, London, has received a valuable gift of minerals and recent shells from Miss A. Mallet in aid of the equipment for teaching purposes in the faculty of natural science and engineering.

At the first meeting of the governors of Mason University College, Birmingham, which has recently been incorporated, the President of the College (the Right Hon. J. Chamberlain, M. P.) made an important speech on the subject of a Midland University.

Dr. Frank M. McMurry, Dean of the

School of Pedagogy of the University of Buffalo, has been appointed professor of the theory and practice of teaching at the Teachers' College, New York. The study of education and the professional training of teachers will be abandoned at Buffalo at the end of the present year, special measures having been taken to enable the students of Professor McMurry to continue their work under him at Columbia University. Dr. W. B. Elkin, lecturer in philosophy at Cornell University, has been appointed to an instructorship in the theory and practice of teaching.

MR. H. BAGNALL POULTON, M.A., F.R.S., Hope professor of zoology at Oxford University, has been elected to a Fellowship in Jesus College, under the statute providing for the election of 'any person of eminence in literature, science or art whose presence on the governing body would, in the judgment of the Principal and Fellows, be beneficial to the college.

MR. FRANK CLOWES has accepted the position of chief chemist to the London County Council, and has been made emeritus professor of chemistry of University College, Nottingham.

M. LE CHATELIER has been appointed to the chair of mineralogical chemistry in the College de France, vacant by the death of M. Schützenberger, and Professor G. M. Searle has been appointed Director of the Vatican Observatory at Rome in the place of Father Denza. Dr. Straubel has been promoted to an assistant professorship of physics at the University of Jena, and Dr. Brendel, docent in astronomy, to an assistant professorship in the University of Greifswald.

DISCUSSION AND CORRESPONDENCE.

A NOTE ON THE SOUTH AMERICAN COASTAL CLOUD.

TO THE EDITOR OF SCIENCE: The following brief notes on the coastal cloud of the west coast of South America may be considered as supplementary to the notes on clouds printed in SCIENCE for August 27th last.

One of the most interesting features in the meteorology of the desert region which extends roughly from lat. 3° S. to 30° S., along the west coast of South America, is the almost constant presence of a bank of clouds over the coast range of hills and the strip of land immediately adjacent to the ocean. On the writer's voyage up this coast from Valparaiso to Panama, accomplished at intervals during the months from August to January, it was noted that the southern limit of this coastal cloud coincides very nearly with the southern limit of the rainless belt, and that its northern limit may be taken as defined by the latitude at which the zone of heavy rainfall in Ecuador begins and the desert strip ends.

The height of the base of the cloud, which seemed usually to be a low *strato-cumulus*, was determined in a few cases by means of aneroid barometers and found to be between 2,000 and 3,000 feet above sea-level. The vertical thickness of the cloud was found, by reference to the heights of the coast range of hills, to be less than 1,000 feet. As to the width of the cloud, from its seaward to its landward side, a few crossings by railroad from the ocean to the interior country showed an inland extension of roughly between ten and twenty miles. This distance probably depends partly upon the trend of the coast range of hills and partly upon the topography of the region. The extension of the coastal cloud to seaward apparently also varies considerably. Sometimes the shore-line itself was found to mark the limits of the cloud as sharply as if they were drawn with a ruler, and at other times the cloud was noticed extending as far as ten or even fifteen miles off shore.

A study of the growth of the cloud, and of its relations to the clear sky on the seaward and landward sides, would be very interesting. For instance, on December 16th, last, at 8 a. m., when the writer was in Mollendo, there was a very sharp dividing line between the low gray coastal cloud over the land and the blue sky, with a few *cirro cumulus* clouds dotted over it, over the ocean. Later in the morning the coastal cloud extended itself seaward and the sharp line of division was lost. The contrast between the region along the coast covered by this cloud belt and the country inland, beyond the reach of the cloud, is usually very striking. But it is interesting to note that, if a sufficient

distance from the sea and a sufficient altitude are reached, another region of cloud is encountered, so that there are two cloudy zones, separated by a zone over which the sky is prevailingly clear. This contrast was well seen by the writer at the beginning of the cloudy season in December, on trips between Mollendo, on the coast, and Arequipa, 80 miles inland in a direct line, 7,550 feet above sea-level. The same three zones were passed through on a trip up the Oroya Railway, from Callao, at sea-level, to Oroya, 12,178 feet above the sea.

As to the cause of the coastal cloud, that would seem to be found in the prevalence of cool southerly and southwesterly winds—the spiral outflow on the eastern side of the South Pacific anticyclone—blowing along shore or obliquely on shore along the whole desert strip of the Pacific coast of South America. These northward blowing and hence warming winds flow from a cool ocean surface on to a warmer land. They, therefore, becoming warmed, are increasing their capacity for water vapor, and instead of being rain-bearing, as might be expected in the case of on-shore winds which are forced to ascend by the topographic conditions, they are hostile to the production of rain. It is true, to be sure, that the adiabatic cooling due to their enforced ascent over the low coastal hills is sufficient to produce cloudiness, but it does not seem sufficient, in most cases, to produce precipitation. North of Paita, where the cold ocean current and the southerly winds turn off to the westward, the barren strip comes to a sudden end, and the coastal cloud, so far as could be determined by the observations of only one voyage, comes to an end also.

That the range of hills along the coast plays an important part in the production of the coastal cloud was shown by the fact that where the immediate seacoast is low, as, *e. g.*, at and for a short distance north of Pisco, there the coastal cloud was absent.

R. DeC. Ward.

Colon, Colombia, January 12, 1898.

Newcomb's Philosophy of Hyper-Space.

There is in Professor Newcomb's beautiful address (Science, January 7, 1898) a marked naïveté. He says: "Certain fundamental axioms are derived from experience, not alone individual experience, perhaps, but the experience of the race." On the contrary, the hereditary geometry, the Euclidean, is underivable from real experience alone and cannot be even proved by experience. Its adequacy as a subjective form for experience has not yet been disproved, but might in future be disproved. It can never be proved.

The realities which with the aid of our subjective space form we understand under motion and position, may, with the coming of more accurate experience, refuse to fit in that form. Our mathematical reason may decide that they would be fitted better by a non-Euclidean space form. But we are, and shall be, helpless to get such a space form from any experience whatever.

Space is presupposed in all human notions of motion or position. We may drop out such specifications from our space form as render it specifically Euclidean, but we cannot replace them by non-Euclidean. Euclidean space is a creation of that part of mind which has worked and works yet unconsciously.

It is not the shape of the straight lines which makes the angle-sum of a rectilineal triangle a straight angle. With straight lines of precisely such shape, but in a non-Euclidean space, this sum may be greater or less. In non-Euclidean spaces, if one edge of a flat ruler is a straight line the other edge is a curve, if the ruler be everywhere equally broad. In any sense in which it can be properly said that we live in space, it is probable that we really live in such a space. What becomes of the dogma that fundamental axioms are derived from experience alone?

George Bruce Halsted.

Austin, Texas.

Scientific Literature.

Traité des variations du système musculaire de l'homme, et leur signification au point de vue de l'anthropologie zoologique. Par Le Dr. A.-F. Le Double, Professeur de l'anatomie a l'École de Médecine de Tours, avec une préface de M. E.-J. Marey. En deux volumes. Paris, Schleicher Frères. 1897.

During the last twenty years large numbers of scattered observations on muscular anoma-

lies have been published, together with attempts at explanation of their significance, which for the most part have left a good deal to be desired. Testut's work on this subject, published in 1884, has been the only at all systematic account. The present one, however, supersedes it, both from its greater scope and from its more philosophic spirit. The work of analyzing the variations of each muscle, of grouping together the observations of others and discussing the comparative anatomy, has been most thoroughly done, so that the book is indispensable to all workers in this branch of anatomy.

At the end of the second volume are the general considerations, treating among other things of the classification and significance of anomalies. We should say, in the first place, that, though Le Double occasionally uses the word *anomaly*, he has chosen *variation* as the correct one, holding that the former implies a knowledge of all the laws and of the fixity of species, which last he evidently does not believe in. He rejects unity of plan as any explanation, though he quôtes a really eloquent passage from Geoffroy Saint-Hilaire in support of it. On the other hand, he is not only more conservative, but more philosophic than those who would call all anomalies atavistic. As Poirier has written: "Lorsqu'un auteur, pour expliquer le muscle présternnal de l'homme, remonte ou descend jusqu'au serpent, il court grand risque de n'être pas suivi." Le Double points out that in this respect Macalister has done him an injustice by classing him among those of this set.

His system divides variations into three classes: First, regressive, reversive, atavistic and theromorphic; second, progressive ones; third, monstrosities. The last word is not used in quite the ordinary sense, but rather to include such muscles as cannot be made to fit into the other classes. He believes that their number will steadily diminish with the progress of the departments of science bearing on the question.

It is very hard to find two men in accord on the significance of anomalies, but at least the day of those who would call everything atavism and resent criticism is on the wane. On the other hand, a satisfactory explanation of many points is wanting. Without quite agreeing with Dr. Le Double, we wish to call attention to an excellent piece of work that is a true contribution to the facts of anatomy.

THOMAS DWIGHT.

The New Psychology. By E. W. SCRIPTURE. London, Walter Scott; New York, Charles Scribner's Sons. 1897. (Contemporary Science Series.) Pp. xxiv+500. Price, $1.25.

Dr. Scripture here gives us an account of the work which has been carried on in the psychological laboratories. After a general treatment of the methods, he presents, under various heads, the technique and results of a wide range of experiments, and has helped out the narrative by a plentiful use of illustrations. There is also an historical sketch of the rise of experimental research in psychology, together with a chapter on the present state of the work in various lands, to which Professor Binet has contributed some interesting pages on past and present conditions in France. Binet is evidently pleased that the study of hysteria and hypnotism is yielding to an interest in 'aphasia, arithmetical prodigies, memory, the superior intellectual functions, and also the organic and motor functions connected with intellectual states.' He believes 'that French psychology will long continue in this path, on which he entered about 1890.' The book closes with an appendix containing a number of mathematical tables and formulæ.

In the general grouping of experiments Dr. Scripture has taken new and, on the whole doubtful ground. He has attempted to make psychology speak the language of physics by dividing experiments into those involving Time, Energy and Space. The division entitled 'Energy' is the rag-bag into which everything is thrown that doesn't readily fall under 'Time' or 'Space.' The scheme is an awkward one, and if it gives some borrowed feeling of scientific exactness it can only be at the expense of clear thinking in the purely psychological field. Classification is, at best, a thankless task; but since it has to be done it would seem best to group experiments more according to the mental process we are really investigating than according to the object on which this process plays. For instance, from a psychological stand-

point there is a deeper kinship between an experiment on the discrimination of space-intervals and one on the discrimination of time-intervals than there is between the latter and experiments in simple reaction-time. And yet in the author's arrangement the mere difference in the object separates the various experiments on discrimination by nearly the thickness of the book, while the time elements bring reaction experiments close to those on the estimate of time-intervals, although the mental processes investigated in these experiments are as different as can be.

But it is when interpreting experimental results that the author shows to least advantage. If one were to generalize on the character of the new movement in psychology from such writings as this, one might say that the 'New Psychology' is wofully lacking in psychological insight. There is tireless nicety in gathering 'facts,' only to make slovenly generalizations which these facts do not warrant. Emerson could have pointed to this as another illustration of his wide law of compensation. If the older psychology was deficient on the side of exact experiment, the new seems too often wanting in any clear notion of what the experiments prove.

Many illustrations of this could be gathered from the book, but the single instance of tap-time must suffice. The rapidity with which taps can be given on an electric key is assumed by the author to indicate the rate at which we can make separate acts of will. In truly scientific work, however, it would seem appropriate that the same exactness which is displayed in recording and counting the taps should also be used in determining whether these separate movements of the finger are really due to separate acts of will. To the present writer, at least, the maximum rate of tapping seems to be obtained by a peculiar muscular tension which is preserved (it is true) by an act of will, but the separate oscillations of the finger are no more indicative of distinct acts of will than a sustained rigidity would imply a separate volition for each unit of time the contraction was maintained. Let us, by all means, have the spark-method and full tables of mean variation and all else that scientific accuracy may require, but let us not neglect the weightier matters of the law.

But, in spite of these and other defects, the volume gives a really valuable account of the more mechanical side of the experimental work, and contains in small compass much that had never been gathered into any single book. So that Dr. Scripture has done good service in collecting and arranging all this material. It is to be regretted that the author's unfortunate manner will, in too many cases, prevent even his account of laboratory contrivances, in which he is at his best, from getting the hearty recognition which the reader would otherwise be sure to give.

G. M. Stratton.
University of California.

Traité élémentaire de mécanique chimique, fondée sur la Thermodynamique. By P. Duhem. Paris, A. Hermann. 1898. Vol. II. Large 8vo. Pp. 378. Price, paper, 12 fr.

In treating the subject of chemical equilibrium one can classify the matter according to components and subdivide according to variance, or one can reverse this, classifying according to variance and subdividing according to components. The first method is well adapted to books on qualitative equilibrium, in which the object is to get a clear view of the behavior of a system as a whole. In books on quantitative equilibrium it seems more rational to group like equations together, and for that reason it is better to discuss all nonvariant systems and then all monovariant systems. Since this second method has not yet been adopted by any one, it is perhaps not surprising to find that Duhem has chosen the other in preference. The present volume, the second of the series, treats of the laws describing one-component systems and the systems which can be made from these by addition or subtraction of heat or work. This last statement may not be clear without some explanatory comment. If we start with solid ammonium chlorid we certainly have a one-component system, and this is not altered by the fact that the vapor given off by this substance is composed chiefly of ammonia and hydrochloric acid. If we are not to make any distinction between a substance which dissociates in the vapor phase and one

which does not, there is no question but that we should take up next the case of a substance which dissociates into a vapor and a liquid or a vapor and a solid. An instance of this last is calcium carbonate, which dissociates on heating, forming carbonic acid and calcium oxide. This is a two-component system, but it has been derived from a one-component system by heating, and is therefore discussed by Duhem. This is a very ingenious way of attacking the subject, and has the great merit that the transition from one to two components is made gradually and not abruptly. It has the disadvantage that one has to cover this intermediate ground a second time when studying two-component systems. What Duhem has done is to consider, in this volume, systems such that the sum total of all the masses in all the phases can be represented by the chemical formula for a compound.

The book is divided into three parts, the first of which includes saturated vapors, the phenomena of boiling, change of freezing point and equilibrium between solid and solid, dissociation curve for two solids and vapor, the triple point and the curves meeting in it. The second part of the volume deals with the continuity between the liquid and the gaseous states, while dissociation in the vapor phase is taken up in the closing section. Of special interest are the chapters on the phenomena of boiling, on apparent false equilibrium as applied to boundary curves, on dissociation in gases and on the theory of false equilibrium. The book attempts, in an admirable manner, to present exact theory in such a form as to be applicable to experimental data and not to hypothetical or simplified phenomena. Of course, this is a goal which no treatise can hope to attain at the present time; but this volume of Duhem's comes nearer to it than anything that has yet been published. It is not too much to predict that the whole study of organic chemistry will be revolutionized as soon as the points of view suggested by Duhem become well understood. All the phenomena connected with isomerism become capable of quantitative treatment as soon as they are studied experimentally with reference to the theory of false equilibrium and the theory of permanent changes recently developed by Duhem. It seems probable that it will be possible, by application of these same two theories, to make an intelligent study of all chemical reactions not involving more than four components.

WILDER D. BANCROFT.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 478th meeting of the Society was held at the Cosmos Club at 8 p. m., on January 22d. Two papers were presented: The first by Dr. Walter Hough on the 'Origin and Range of the Eskimo Lamps.' The conclusions reached were: That the Eskimo before he migrated from his pristine home had the lamp, this utensil being a prerequisite to migration into high latitudes. That one of the most important functions of the lamp is for melting snow and ice for drinking water. That the lamp is employed for lighting, warming, cooking, melting snow, drying clothes and in the arts, thus combining in itself several functions which have been differentiated among civilized peoples. That the architecture of the house is related to the use of the lamp. The house is made non-conducting and low in order to utilize the heated air. That the lamp is a social factor, peculiarly the sign of the family unit, each head of the family (the woman) having her lamp. That the invention of the lamp took place on some seacoast, where fat of aquatic mammals of high fuel value was abundant, rather than in the interior, where the fat of land animals is of low fuel value. That the typical form of the lamps arises from an attempt to devise a vessel with a straight wick edge combined with a reservoir giving the vessel an obovate or ellipsoidal shape.

Finally, from observation of lamps from numerous localities around the Eskimo shoreline, it is concluded that lamps in low latitudes below the circle of illumination are less specialized than those of higher latitudes. For instance, the lamps of southern Alaska have a wick edge of two inches, while those of Point Barrow and northern Greenland have a wick edge of from 17 to 36 inches in width. It becomes possible, then, to say with some certainty the degree of north latitude to which a lamp appertains, light and temperature being

modifying causes. Driftwood, the fuel supply, and the presence or absence of materials from which to construct the lamp must also be considered. The cause of the large lamps coming down so far in latitude on the east is on account of the dipping of the isotherms. The lamps of Labrador are a case in point. There are three kinds of Eskimo lamps—the house lamp, the small lamp for temporary use by hunters and travellers, and the mortuary lamp.

The second paper, by Mr. René de Saussure, on 'A New Method of Plotting Maps and Charts,' was omitted on account of the author's inability to be present.

The third paper, by Professor J. H. Gore, was entitled 'Gheel, a Colony of the Insane.' This last paper was both highly interesting and instructive, but no abstract of it is available at the present moment. E. D. Preston,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the regular meeting of January 26, 1898, one of the principal communications was on the Montreal meeting of the Geological Society of America, by Mr. David White and Mr. Whitman Cross, both of the United States Geological Survey, a subject which has already been fully reported in these columns. There was also some discussion of the paper that was read by Mr. Cross at the preceding meeting.

Mr. G. K. Gilbert, United States Geological Survey, gave a description of the Pueblo (Colo.) folio of the Atlas of the United States, a folio just completed. The ground that he went over is fully covered in the printed descriptions to accompany the folio. W. F. Morsell.
U. S. Geological Survey.

THE ENGELMANN BOTANICAL CLUB.

The club met at the Shaw School of Botany, St. Louis, on January 13th, thirty-four members present. The following officers for 1898 were elected: President, William Trelease; Vice-Presidents, Geo. W. Letterman, Henry Eggert; Secretary, Hermann von Schrenk.

Professor L. H. Pammel briefly discussed the flora of Iowa, giving an account of the topography and climatology, and their bearing on the distribution of plants in that State. He spoke of a series of ponds which had dried to such an extent that the collected humus burned when lighted. These ponds had been flooded last year and a surprisingly large number of aquatic plants had apparently survived the drying process.

Mr. J. B. S. Norton spoke on the coloring matter of some Borraginaceæ. He described some specimens of *Plagiabothrys Arizonica*, which stained paper a violet-purple, and attributed this to alkanin. The occurrence of this dye in other North American Borraginaceæ was discussed.

Mr. H. von Schrenk presented some notes on the dry-rot fungus, *Merulius lacrymans*, which had been found in the beams of a building in which the floors had fallen in. He exhibited specimens of the fungus collected in fallen cypress logs in northwestern Mississippi. Some other fungi collected in that region were discussed. Hermann von Schrenk,
Secretary.

NEW BOOKS.

The Sun's Place in Nature. Norman Lockyer. New York and London, The Macmillan Co. 1897. Pp. xvi+360. 12s.

Various Fragments. Herbert Spencer. New York, D. Appleton & Co. 1898. Pp. 208. $1.25.

The Mystery and Romance of Alchemy and Pharmacy. C. J. S. Thompson. London, The Scientific Press, Ltd. 1897. Pp. xv+335.

The Barometrical Determination of Heights. F. J. B. Cordiro. New York and London, Spon & Chamberlain. 1898. Pp. 28. $1.00.

Traité de zoologie concrète. Yves Délage and Edgard Hérouard. Volume V. *Les vermidiens.* Paris, Schleicher Frères. 1897. Pp. xi+372.

Le Rationnel. Gaston Milhaud. Paris, Alcan. 1898. Pp. 179. 2 fr. 50.

Energetische Epigenesis und epigenetische Energieformen. George Hirth. Munich and Leipzig, G. Hirth. 1898. Pp. xiv+218.

Outlines of Sociology. Lester F. Ward. New York and London, The Macmillan Company. 1898. Pp. xiii+301. $2.00.